

Aviation Week

Including Space Technology

75 Cents

A McGraw-Hill Publication

June 8, 1959

Gulfstream
Production
Hits Stride



Doak VZ-4DA VTOL

Pilot Report on Orbital Test in Centrifuge



PRESCRIPTION FOR WEIGHT CONTROL...

Vo Shan weight/master hex nuts combine a considerable saving in weight together with a carefully engineered design that meets the needs of a wide range of industry requirements.

Well known Vo Shan's superior quality control and production methods assure a consistent, high reliability and attractiveness whatever weight/master is specified. Excess metal has been removed without loss of full performance.

weight/master hex nuts



Now in quantity production, in sizes 4-40 through 1/2-24, the weight/master hex nut is recognized as a successful answer to weight control problems. The chart shows weight/master hex nuts and proposed MS part numbers. HAS part numbers will be announced shortly.

VO SHAN #	MS #	MS#	WE 125-1000 Pcs.
MS 300-40	MS 33040-06	6-06	10
MS 300-42	MS 33042-08	8-02	100
MS 300-44	MS 33044-08	8-02	100
MS 300-46	MS 33046-10	10-02	100
MS 300-48	MS 33048-12	12-02	100
MS 300-50	MS 33050-14	14-02	100
MS 300-52	MS 33052-16	16-02	100
MS 300-54	MS 33054-18	18-02	100

For information on these and other Vo Shan fastening products write to:

VOI-SHAN

VOI-SHAN MANUFACTURING COMPANY
8463 Highway Street, Culver City, California

Permit our pride—but we're understanding.

50 years of "FIRSTS"

in the aviation industry!

1909



First pneumatic airplane tire, built by Goodyear to replace steel runways used by Wright brothers.

1959



First in aviation the production and sales every year for half a century—in the first of America's finest jet-towns. More jets and prop-jets now in service land on Goodyear aircraft tires than on any other kind. In fact, there are more Goodyear tires, wheels and brakes in commercial aviation service than all other makes combined.



Other Famous "Firsts" by Goodyear Aviation Products

FIRST low pressure pneumatic engine fire—the *Aviation*

FIRST brake designed specifically for aircraft

FIRST fully automatic system of tire detection and low air warning for aircraft

FIRST subzero tire specified for commercial airlines

FIRST successful self-sealing test tank

FIRST complete line of nylon cast tires for high speed aircraft

—and the best is yet to come!

***NEW TACHOMETER**—capable of speeds in the mph will quickly take on the highest performance aircraft of the 1960's.

***NEW FARMER REINFORCED TIRES AND EXTREME** Goodyear is now qualified to extend jet aircraft tires to new specifications.

***NEW FUSION-BALANCING** assures lasting adhesion in balancing compound seals within tire, perfect balance values.

THE AVIATION TO ANTWERP the ever changing needs of America's airlines has been the only factor in Goodyear's 50 years of aviation achievement. From the industry shifts to jet power—developments ready to meet the challenge of longer ground distances, faster flights. After 50 years of anticipating these needs now—developing will more Goodyear "Firsts" for tomorrow and for the future.

Goodyear Aviation Products maintains the largest field service staff of its kind in the industry. These trained service representatives strategically located throughout the nation—serve commercial airlines and General Aviation—maintain every aircraft and wherever needed.

AVIATION PRODUCTS BY

GOODYEAR

Goodyear is a registered trademark of Goodyear Tire & Rubber Company, Akron, Ohio

what can you do with this versatile FLUID HANDLING HARDWARE?



**H₂O₂ NOZZLE and ADAPTER
Model QD-7**

For safe, easy venting of oxidant and various adaptability for other fuels.

- Self-sealing
- Lightweight
- Working parts isolated from fluid
- Nozzle mach to 1/16" for adaptor to exhaust internal valves
- Sizes: 1/2" to 5" I.D.
- SO to 1,500 gpm.

QUICK DISCONNECT Model QD-2

For security-critical surface power plants or environmental systems. Can be used for remote operations and a wide range of fluids, gases or liquid metals.

- "Push-to-lock", "pull-to-open"
- Both halves self-sealing
- Both disconnect during flex operations
- Proof pressure — 300 psi
- Sizes: 1/2" to 6" I.D.



**MAGNETIC FLUID
LEVEL INDICATOR**

Depicts changing of tank fluid levels in any binary or multi-level control equipment. Any use with gas diffusion for a variety of tank depths.

- Easy, under-the-tank check
- Lightweight
- Easy to install
- No power requirements
- No complex hidden linkages



**FLOAT SWITCH
Model FS-2**

Operates electrically controlled valves and indicator lights. For check-out or alarm fluid systems.

- Inducted switch mechanism
- Weighs only 10 lbs.
- 7-ampere inductive load at 24 v-DC
- Highly-reliable where fluid levels change rapidly

FREE CATALOG . . . simply request on your letterhead. Electronic complete facilities for development and manufacture of systems and components for fluid transfer, airborne suspension, metering and other applications. Includes details on use at military and industry approved products.



Flight Refueling, Inc.

MEMBER INTERNATIONAL AIRCRAFT & AIRCRAFT S.A. INC.

West Coast Representative: William E. Smith, P.O. Box 442, Inglewood, Calif.

AVIATION CALENDAR

(Continued from page 3)

- Ann. of Inst. Transport Vehicle, Van Nuys, Calif.
- July 30-31-32nd Annual Symposium on Computers and Data Processing, Downers Grove Institute, Wheat Ridge, Colo.
- Aug. 4-5-Second Annual Western Regional Meeting, American Astronautical Society, Anaheim Hotel, Los Angeles, Calif.
- Aug. 15-16-William Fiedrich Dornier General Conference on the problems of hypersonic and space flight, Stanford University, Stanford, Calif.
- Aug. 17-First National Ultrasonic Symposium, Institute of Radio Engineers, Professional Group on Ultrasonic Engineering, Stanford University, Stanford, Calif.
- Aug. 18-21-Medica Electronic Show & Conference, Institute of Radio Engineers, San Francisco, Calif.
- Aug. 24-26-Cos. Dornier, Spaceplane Symposium, Rocket Society, Northampton University, London, U.K.
- Aug. 24-26-Institute of the Astronomical Sciences National Specialists Meeting, a symposium on radio astronomy, workshop, Stanford, San Diego, Calif.
- Aug. 27-28-International Communications Symposium, Church House, Westminster, London, England.
- Aug. 31-Sept. 5-1st Joint Congress, International Astronautical Federation, Church House, Westminster, London.
- Sept. 12-Cosmocon, on physical sciences in space, and space flight, University of Pennsylvania, Philadelphia, Pa. Sponsors: Air Force Office of Scientific Research and Control, Electric Co. of North and South, Natick, Mass.
- Sept. 14-1979 Congress Engineering, Cos. Lunacy, University of California, Berkeley, Calif.
- Sept. 15-National Guidance and Navigation Symposium, Air Force Armory, Radio Hall, Miami Beach, Fla.
- Sept. 20-22-1979 Rand Research Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, Eng.
- Sept. 24-25-3rd International Conference on Fluid and Solid Mechanics, University of Texas, Austin, Tex. Sponsors: ASEE/Thermodynamics Association, Office of Naval Research, National Research Foundation Dr. M. J. Thompson, Cleveland, Department of Automobile Engineering, University of Toronto.
- Sept. 25-26-Flight and Operations Symposium, Aerojet Corp., Azusa, N. J.
- Sept. 26-27-28th Applied Mechanics Conference, Veterans Rocket Society, Princeton University, Princeton, N. J.
- Sept. 28-Nov-1979 National Symposium in Astronautics, Cos. Dornier, and Wernicke, Hotel San Francisco, Calif. Sponsors: Institute of Radio Engineers, Professional Group on Space Electronics & Telecommunications.
- Oct. 15-16-National Aerospace Meeting, Society of Automotive Engineers, Air Transportation, Los Angeles, Calif.
- Oct. 16-17-18th Annual Meeting, National Research Council, Ann. Hotel, Lansing, Mich. Sponsors: ASEE.
- Oct. 12-13-14th General Convention of the International Air Transport Assn., Tokyo, Japan.



Motor actuated

... at -425° F

Hydromatics FLO-BALL valves

Hydromatics makes them all . . . shutoff, bleed and ground support. These motor-operated FLO-BALL valves offer the optimum combination of 100% flow efficiency, perfect sealing, positive on-off and high speed response as fast as 200 millsec.

For airborne applications, these valves offer extreme compactness and light weight. In sizes from 1/4" to 3", for pressures up to 4,000 psi, and temperatures to -425° F.

For ground support, motor-operated FLO-BALL valves up to 8" afford great system simplification and shutoff ability . . . for temperatures as low as -425° F and pressures up to 3,000 psi.

Write for complete information on Hydromatics FLO-BALL valves . . . motor, pressure, or manually actuated . . . for high pressure, cryogenic, and corrosive applications.

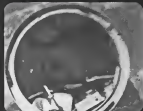
Hydromatics, Inc.

LIVINGSTON, N. J. • WYMAN 3-1950 / LOS ANGELES, CAL. • DIAMOND 6-6950

Copyright 1979, Hydromatics, Inc.



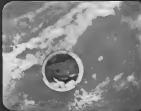
USAF Gets Dramatic Film from Outer Space



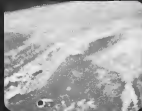
Two men separate from re-entry vehicle and camera shows inside hatch portion of the vehicle which had housed the re-entry vehicle.



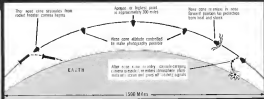
Camera continues to photograph repetitive portions of flight; shows the inside will be foreground with Earth just visible.



Distance between re-entry vehicle and vehicle grows; about 100 miles is visible above Atlantic Ocean and Florida.



At the distance of 200 miles in space, camera shows white Earth and sky panorama and now distant falling Thor missile is just visible.



NESTOR'S ILLUSTRATION shows sequence of events as they occurred during historic Thor re-entry vehicle flight.



"SPACE CAMERA" is inserted in MEVD-developed re-entry capsule which was placed in Thor re-entry vehicle.



USAF RECOVERED CAPSULE from Atlantic 1480 miles from Cape Canaveral only 39 minutes after missile launching.

General Electric Missile and Space Vehicle Department Equipment on USAF Thor Missile Makes Possible Pictures of Earth Never Before Achieved, Successful Ocean Recovery from Ocean

Now, for the first time:

- a motion picture has been made of Earth from outer space at distances from 60 to 300 miles and has been successfully returned through the Earth's atmosphere.
- sounds on view in film sequence that show a missile in actual space flight performing functions never actually seen before.

To obtain this historic motion picture, a USAF Thor missile launched from Cape Canaveral on May 12 carried a General Electric-developed re-entry vehicle housing a recoverable capsule which contained a 16-millimeter camera. As the Thor booster and re-entry vehicle separated, approximately 90 miles up over the Atlantic Ocean, the camera was triggered into operation and began for the first time an actual film recording of a reentry sequence in space. As the camera-carrying re-entry vehicle sped on its way into space, the booster fell farther and farther away revealing an expanding panorama of Earth.

General Electric's Missile and Space Vehicle Department in Philadelphia developed and built both the re-entry vehicle and the recoverable capsule used in the flight. In addition, G-E engineers overcome complex engineering problems to make possible reentry vehicle stabilization and control required for zero-photograph. After separation, the re-entry vehicle was repositioned

in flight so that the rear of the vehicle was directed toward Earth and the descending booster section just prior to recovery, however, the re-entry vehicle's blunt heat shield was turned toward Earth to cope with the terrible heat and shock of re-entry through the atmosphere.

As the Thor re-entry vehicle passed the end of its 1580-mile flight over the Atlantic, the recoverable capsule containing the camera and film was ejected, plummeting into the sea. The capsule was designed by G-E MEVD engineers to withstand the tremendous pressure occurring during the impact. Floating to the surface, the capsule began sending recovery radio signals. Dye markers and flashing lights were also activated to aid in recovery.

Proved in three prior consecutive successful cases, however, the MEVD capsule functioned completely as programmed. It was recovered by an Air Force coast guard vessel near the Island of Antigua . . . only 34 minutes from the time of actual reentry launch.

Through its development of more sophisticated space vehicle control techniques, through its contribution in solving the historic missile re-entry problem and through its continuing space technology research and development program, General Electric's Missile and Space Vehicle Department continues to be the leader in space technology program. Missile and Space Vehicle Department, Philadelphia, Pa., of the Defense Electronics Division.

DA-100

GENERAL  ELECTRIC

MRC RELIABILITY



As the navigator relies on the North Star—so aircraft and missile guidance systems depend on reliability of components. MRC Super-Precision Instrument Bearings offer the highest degree of accuracy and performance.

MRC
BALL AND ROLLER
bearings

MARLIN-ROCKWELL CORPORATION Jamestown, New York

THE SOUNDING 100-99 BOMARC is a long-range, extremely high altitude supersonic missile designed to intercept and destroy enemy aircraft and missiles. In full production, it has a cruise range that may allow air defense needs.



STRUCTURAL EFFICIENCY CONTRIBUTES TO GREATER PERFORMANCE

The airframe of the Bomarc reflects a successful solution to structural and fastening design problems typical to high performance missiles and aircraft. The airframe combines high strength with high temperature resistance, without adding unnecessary weight which could effect performance.

Three different fastener problems in the Bomarc are solved by stainless steel Hi-Shear fasteners. Hi-Shear Rivets are used in structure subjected to engine and rocket boost heat. Hi-Torque Bolts fasten removable panels and the nose section where heat, surface smoothness and ease of removal are factors. Blind Nuts eliminate hole/vent coordination problems in congested areas.

Continuing fastener environmental studies are being conducted at the Hi-Shear Test and Research Laboratories in a variety of strength and temperature resistance material combinations for advanced structural requirements.



HI-TORQUE BOLT

IDEAL FOR WITHSTANDING EXCESSIVE HEAT AND STRESS WITH MINIMAL WEIGHT PENALTY. QUALITY BOLTS LONGER LIFE SERVICE. MADE IN STEEL. A HIGH TENSILE STRENGTH IS APPLIED. BOLTS BEING USED IN THE BOMARC.



HI-SHEAR RIVET

USE THE HIGHEST STRENGTH MATERIALS (STEEL, TITANIUM, AND INCONEL) FOR THE MOST DURABLE FASTENERS. QUALITY BOLTS LONGER LIFE SERVICE. MADE IN STEEL. A HIGH TENSILE STRENGTH IS APPLIED. BOLTS BEING USED IN THE BOMARC.



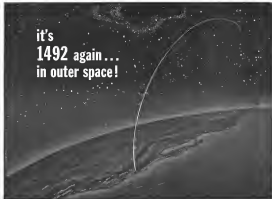
BLIND NUT

FOR BLIND OR OTHER APPLICATIONS, THE BLIND NUTS CAN BE INSTALLED IN THE HOLE. THE NUTS ARE MADE OF THE HIGHEST STRENGTH MATERIALS (STEEL, TITANIUM, AND INCONEL) FOR THE MOST DURABLE FASTENERS. QUALITY BOLTS LONGER LIFE SERVICE. MADE IN STEEL. A HIGH TENSILE STRENGTH IS APPLIED. BOLTS BEING USED IN THE BOMARC.



2600 WEST 24TH STREET, TORRANCE • CALIFORNIA

it's
1492 again...
in outer space!



Philco Ground-Space Communications System commands and tracks DISCOVERER satellite

DISCOVERER... the United States' newest earth satellite... is opening new vistas on the frontiers of outer space. And Philco is proud to play an important role in that noteworthy achievement as a part of the Discoverer Team... in cooperation with the Lockheed Aircraft Corporation, and the Air Force as the director of the Advanced Research Project Agency of the Department of Defense.

As the subcontractor for Discoverer's entire communications system, Philco designed and developed the vast complexity of ground space communications, tracking, commanding and data gathering and processing systems.

The Philco-designed and equipped system observes and commands Discoverer through a series of

five tracking and data collection stations in Alaska, California, Illinois and a specially equipped ship at sea. Philco continues its participation in the Discoverer Program by assisting in the actual operation and maintenance of the communications and data handling network.

Philco's part in the Discoverer Program is typical of the many and diverse advanced research and development projects being conducted in our laboratories on the East and West Coasts where outstanding talent opportunities abound for Engineers, Mathematicians, and Physicists.

In the wonder-world of advanced electronics, look to the leader. Look ahead...and you'll choose Philco!

PHILCO®

GOVERNMENT AND INDUSTRIAL DIVISION
WESTERN DEVELOPMENT LABORATORIES
PHILADELPHIA, PENNSYLVANIA FALD ALTO, CALIFORNIA



all-weather radar finds  the calm corridor



Providing a clear picture of subsurface cells in station ahead, Hughes' TOSCOM® tube gives you all-weather, weather radar, long-range ability to find the "calm corridor."

Hughes' TOSCOM tube gives you several features which make it ideal for weather radar systems and ground mapping.

Full Gray Scale—allows different shades of gray.

High Picture Brightness—for areas of 1000 foot luminance with full brightness range. Even in full sunlight no viewing hood is required—thereby providing maximum safety.

Controlable Persistence—Gives you flexibility in watching the complete weather picture.

Developed by the famed Hughes Research and Development Laboratories, the TOSCOM tube is just one of the nation's largest family of design tubes!

For further information about the TOSCOM tube, please write: Hughes Products, Electron Tube Sales, International Airport Station, Los Angeles 34, California.



The new **Rubin II** Weather Radar from the Hughes TOSCOM tube has a high clarity, a clear, non-reflective, wide area system that can keep an area as great as 150 miles ahead and to the right and left, under all-weather conditions—day or night.

The Hughes TOSCOM tube

Applications: Airborne weather radar, "B" band radar, automatic control radar, plus precise electronic info system and time-variant systems.

Available models: Electrostatic deflection, 10 inch, 8 inch and 5 inch diameters. Magnetic deflection, 5 inch and 3 1/2 inch diameters.

TUBE MADE IN U.S.A.

Creating a new world



with electronics

HUGHES PRODUCTS

10000 PAVING STREET, CHICAGO, ILL.

ENGINEERING DIVISIONS: STODART AND WRIGHT; TUBES DIVISION: PHILCO; ELECTRONIC DIVISIONS: PHILCO; ELECTRONIC DIVISIONS: PHILCO; ELECTRONIC DIVISIONS: PHILCO



The Penelone structure, developed by an industrial team in cooperation with the U. S. Army Development Corps, was designed to meet Defense Corps requirements for a mobile antiaircraft shelter.

NEW BIRDAIR STRUCTURE to guard our nation's defenses

COOPERATING MANUFACTURERS

Nylon Sare Fabric by
WELLINGTON BEARS CO.
311 WEST 40th STREET • NEW YORK 18, NEW YORK
Special fabric contractors for the Penelone were supplied by Wellington Bears, manufacturers of famous "Wellstar" nylon fabric recently recognized for merit and long-time quality.

Special Fabric by
THE H. M. SAWYER DIVISION
BENTON-TOWNE, INC.
WATERTOWN 25, MASSACHUSETTS
Special vinyl covering compounds and their application to meet rigid military specifications were provided by Sawyer for the Penelone. Sawyer's "Tall-Grip" is world renowned for its excellent properties and high quality.

Jetation Equipment by
THE PERLESS ELECTRIC CO.
1801 W. MARKET STREET • KANSAS, 66105
The "Jetor" of the Penelone, its exhaust and air recirculation systems, were provided by Perless, builders of a complete line of high quality air moving equipment.... fans, blowers, and electric motors.

This is Penelone, the largest air-supported structure ever built for military use. It is made up of five one-foot deep, and four-inch — diameter which can be used either in combination, or individually.

The dome dome is 110 feet in diameter and 35 feet high, the smaller domes, 130 feet in diameter and 38 feet high. A total ground area of 50,000 sq. ft. and volume of over 1,000,000 cu. ft. are protected.

High regulated nylon fabric is the basic construction material, shape and stability are controlled (and maintained) through constant low-pressure, high volume, air supplied by electric powered blowers.

Then, as rigid supports, poles or beams are applied. These are on elevators to facilitate the fast movement of activities or other large pieces of equipment.

The Penelone is held in place by anchor system into the ground around its perimeter. It is designed to withstand a constant wind load of 18 miles per hour and gust loads of greater velocity.

For sure, there is simply nothing else, not even the Penelone, that provides undivided installation long term use. A defense Penelone dome can be transported on standard military vehicles.

Although developed as mobile inspection and maintenance shelter, the Penelone finds numerous applications to have many other military and commercial applications. For example, experts have suggested an use as a storage enclosure, as a protection for construction activities, and as an exhibit enclosure.

If you have a problem that might be solved with this new approach in space enclosure, we will be glad to send complete explanation, or to arrange a conference at your convenience. Address requests to:

BIRDAIR STRUCTURES, INC.
Dept. A-1, 290 Lakes St., Tulsa 10, N.Y.
Originators of Modern Air-Supported Structures



RE-ENTRY SHIELDS



WYMAN-GORDON IS FORGING RE-ENTRY SHIELDS

- Copper in production
- Beryllium in limited production
- Reinforced plastics in development

WYMAN-GORDON

FORGING

ALUMINUM INCONEL STEEL TITANIUM BERYLLIUM MOLYBDENUM COBALT
AND OTHER UNCOMMON MATERIALS
WORCESTER, MASSACHUSETTS

BAYVIEW, ALABAMA
DETROIT, MICHIGAN

GRAFTON, MASSACHUSETTS
FORT WORTH, TEXAS

FRANKLIN PARK, ILLINOIS
LOS ANGELES, CALIFORNIA



A SALUTE TO THE WORLD'S LARGEST HELICOPTER OPERATION

A Right line of almost 100 helicopters... that's Camp Walters, Texas where U.S. Army Aviators and its civilian contract operator Southern Airways train up its graduates as many as 100 trained helicopter pilots each month. The son of the Army Primary Helicopter School can't tell whole story by any means. Camp Walters affords military-civilian management has achieved an unmatched safety record, and a maintenance hour to flight hour ratio as their 100% Heller fleet that is one-half that of the military average. It proves, too, that a Heller H-23 is as rugged as it looks.

HILLER



AIRCRAFT CORPORATION

PALEO AUTO, CALIFORNIA • WASHINGTON, D.C.
ADVANCED ENGINEERING DIVISION, SAN CARLOS, CALIFORNIA



what is light?

A candle in a dark room?

Transverse and/or Visible electromagnetic waves?

A universal constant?

How many wave lengths in a photon?

Is light affected by gravity?

A full appreciation of light and all its phenomena is essential to the successful completion of our energy conversion mission.

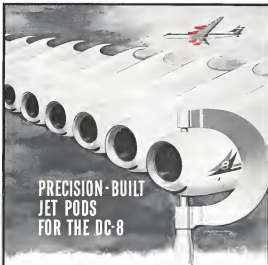
We use this knowledge constantly... as, for example, in our recent development of a photovoltaic-concentrator system and a multispectral-optical system to convert light energy to electrical energy.

To add us to our inquiries we call on the talents of General Motors Corporation, its Divisions and other individuals and organizations. By applying the systems engineering concept to new research projects, we increase the effectiveness with which we accomplish our mission—exploring the needs of advanced propulsion and aerospace systems.

Energy conversion is our business



Division of General Motors, Indianapolis, Indiana



PRECISION-BUILT JET PODS FOR THE DC-8

PROBLEM—package the power of 16 turbines, trees and surface at 10 a day, streamlined pod.

SOLUTION—1) design 100 power plant, aerodynamic, and aircraft structure engineers to work closely with Douglas design specialists; 2) put reactive-craftsmen through postgraduate training program; 3) design and build the finest precision jets and tools; 4) meet the most exacting standards ever established for no-frame manufacturer.

RESULT—glowering pods that receive ready-to-go jet power for Douglas superb DC-8 Jetliner and

supporting pylons also built by Ryan. These jet pods are an important contribution to the success of another great new airliner—created in the finest Douglas transport tradition.

Ryan is well-equipped to meet the challenges of precision production of DC-8 pods and pylons. For more than 25 years Ryan has produced air frame and engine structures for Douglas planes. Ryan is proud of the long association and the confidence which Douglas has placed in Ryan products and the confidence of their performance.

RYAN BUILDS BETTER

Ryan Aeronautical Company, San Diego, Calif.

Aviation Week

Including Space Technology

June 9, 1959

Vol. 70, No. 23
Master: AFP and ABC

INTERNATIONAL OFFICE: New York 100-222-1100, 100-222-1101, 100-222-1102, 100-222-1103, 100-222-1104, 100-222-1105, 100-222-1106, 100-222-1107, 100-222-1108, 100-222-1109, 100-222-1110, 100-222-1111, 100-222-1112, 100-222-1113, 100-222-1114, 100-222-1115, 100-222-1116, 100-222-1117, 100-222-1118, 100-222-1119, 100-222-1120, 100-222-1121, 100-222-1122, 100-222-1123, 100-222-1124, 100-222-1125, 100-222-1126, 100-222-1127, 100-222-1128, 100-222-1129, 100-222-1130, 100-222-1131, 100-222-1132, 100-222-1133, 100-222-1134, 100-222-1135, 100-222-1136, 100-222-1137, 100-222-1138, 100-222-1139, 100-222-1140, 100-222-1141, 100-222-1142, 100-222-1143, 100-222-1144, 100-222-1145, 100-222-1146, 100-222-1147, 100-222-1148, 100-222-1149, 100-222-1150, 100-222-1151, 100-222-1152, 100-222-1153, 100-222-1154, 100-222-1155, 100-222-1156, 100-222-1157, 100-222-1158, 100-222-1159, 100-222-1160, 100-222-1161, 100-222-1162, 100-222-1163, 100-222-1164, 100-222-1165, 100-222-1166, 100-222-1167, 100-222-1168, 100-222-1169, 100-222-1170, 100-222-1171, 100-222-1172, 100-222-1173, 100-222-1174, 100-222-1175, 100-222-1176, 100-222-1177, 100-222-1178, 100-222-1179, 100-222-1180, 100-222-1181, 100-222-1182, 100-222-1183, 100-222-1184, 100-222-1185, 100-222-1186, 100-222-1187, 100-222-1188, 100-222-1189, 100-222-1190, 100-222-1191, 100-222-1192, 100-222-1193, 100-222-1194, 100-222-1195, 100-222-1196, 100-222-1197, 100-222-1198, 100-222-1199, 100-222-1200, 100-222-1201, 100-222-1202, 100-222-1203, 100-222-1204, 100-222-1205, 100-222-1206, 100-222-1207, 100-222-1208, 100-222-1209, 100-222-1210, 100-222-1211, 100-222-1212, 100-222-1213, 100-222-1214, 100-222-1215, 100-222-1216, 100-222-1217, 100-222-1218, 100-222-1219, 100-222-1220, 100-222-1221, 100-222-1222, 100-222-1223, 100-222-1224, 100-222-1225, 100-222-1226, 100-222-1227, 100-222-1228, 100-222-1229, 100-222-1230, 100-222-1231, 100-222-1232, 100-222-1233, 100-222-1234, 100-222-1235, 100-222-1236, 100-222-1237, 100-222-1238, 100-222-1239, 100-222-1240, 100-222-1241, 100-222-1242, 100-222-1243, 100-222-1244, 100-222-1245, 100-222-1246, 100-222-1247, 100-222-1248, 100-222-1249, 100-222-1250, 100-222-1251, 100-222-1252, 100-222-1253, 100-222-1254, 100-222-1255, 100-222-1256, 100-222-1257, 100-222-1258, 100-222-1259, 100-222-1260, 100-222-1261, 100-222-1262, 100-222-1263, 100-222-1264, 100-222-1265, 100-222-1266, 100-222-1267, 100-222-1268, 100-222-1269, 100-222-1270, 100-222-1271, 100-222-1272, 100-222-1273, 100-222-1274, 100-222-1275, 100-222-1276, 100-222-1277, 100-222-1278, 100-222-1279, 100-222-1280, 100-222-1281, 100-222-1282, 100-222-1283, 100-222-1284, 100-222-1285, 100-222-1286, 100-222-1287, 100-222-1288, 100-222-1289, 100-222-1290, 100-222-1291, 100-222-1292, 100-222-1293, 100-222-1294, 100-222-1295, 100-222-1296, 100-222-1297, 100-222-1298, 100-222-1299, 100-222-1300, 100-222-1301, 100-222-1302, 100-222-1303, 100-222-1304, 100-222-1305, 100-222-1306, 100-222-1307, 100-222-1308, 100-222-1309, 100-222-1310, 100-222-1311, 100-222-1312, 100-222-1313, 100-222-1314, 100-222-1315, 100-222-1316, 100-222-1317, 100-222-1318, 100-222-1319, 100-222-1320, 100-222-1321, 100-222-1322, 100-222-1323, 100-222-1324, 100-222-1325, 100-222-1326, 100-222-1327, 100-222-1328, 100-222-1329, 100-222-1330, 100-222-1331, 100-222-1332, 100-222-1333, 100-222-1334, 100-222-1335, 100-222-1336, 100-222-1337, 100-222-1338, 100-222-1339, 100-222-1340, 100-222-1341, 100-222-1342, 100-222-1343, 100-222-1344, 100-222-1345, 100-222-1346, 100-222-1347, 100-222-1348, 100-222-1349, 100-222-1350, 100-222-1351, 100-222-1352, 100-222-1353, 100-222-1354, 100-222-1355, 100-222-1356, 100-222-1357, 100-222-1358, 100-222-1359, 100-222-1360, 100-222-1361, 100-222-1362, 100-222-1363, 100-222-1364, 100-222-1365, 100-222-1366, 100-222-1367, 100-222-1368, 100-222-1369, 100-222-1370, 100-222-1371, 100-222-1372, 100-222-1373, 100-222-1374, 100-222-1375, 100-222-1376, 100-222-1377, 100-222-1378, 100-222-1379, 100-222-1380, 100-222-1381, 100-222-1382, 100-222-1383, 100-222-1384, 100-222-1385, 100-222-1386, 100-222-1387, 100-222-1388, 100-222-1389, 100-222-1390, 100-222-1391, 100-222-1392, 100-222-1393, 100-222-1394, 100-222-1395, 100-222-1396, 100-222-1397, 100-222-1398, 100-222-1399, 100-222-1400, 100-222-1401, 100-222-1402, 100-222-1403, 100-222-1404, 100-222-1405, 100-222-1406, 100-222-1407, 100-222-1408, 100-222-1409, 100-222-1410, 100-222-1411, 100-222-1412, 100-222-1413, 100-222-1414, 100-222-1415, 100-222-1416, 100-222-1417, 100-222-1418, 100-222-1419, 100-222-1420, 100-222-1421, 100-222-1422, 100-222-1423, 100-222-1424, 100-222-1425, 100-222-1426, 100-222-1427, 100-222-1428, 100-222-1429, 100-222-1430, 100-222-1431, 100-222-1432, 100-222-1433, 100-222-1434, 100-222-1435, 100-222-1436, 100-222-1437, 100-222-1438, 100-222-1439, 100-222-1440, 100-222-1441, 100-222-1442, 100-222-1443, 100-222-1444, 100-222-1445, 100-222-1446, 100-222-1447, 100-222-1448, 100-222-1449, 100-222-1450, 100-222-1451, 100-222-1452, 100-222-1453, 100-222-1454, 100-222-1455, 100-222-1456, 100-222-1457, 100-222-1458, 100-222-1459, 100-222-1460, 100-222-1461, 100-222-1462, 100-222-1463, 100-222-1464, 100-222-1465, 100-222-1466, 100-222-1467, 100-222-1468, 100-222-1469, 100-222-1470, 100-222-1471, 100-222-1472, 100-222-1473, 100-222-1474, 100-222-1475, 100-222-1476, 100-222-1477, 100-222-1478, 100-222-1479, 100-222-1480, 100-222-1481, 100-222-1482, 100-222-1483, 100-222-1484, 100-222-1485, 100-222-1486, 100-222-1487, 100-222-1488, 100-222-1489, 100-222-1490, 100-222-1491, 100-222-1492, 100-222-1493, 100-222-1494, 100-222-1495, 100-222-1496, 100-222-1497, 100-222-1498, 100-222-1499, 100-222-1500, 100-222-1501, 100-222-1502, 100-222-1503, 100-222-1504, 100-222-1505, 100-222-1506, 100-222-1507, 100-222-1508, 100-222-1509, 100-222-1510, 100-222-1511, 100-222-1512, 100-222-1513, 100-222-1514, 100-222-1515, 100-222-1516, 100-222-1517, 100-222-1518, 100-222-1519, 100-222-1520, 100-222-1521, 100-222-1522, 100-222-1523, 100-222-1524, 100-222-1525, 100-222-1526, 100-222-1527, 100-222-1528, 100-222-1529, 100-222-1530, 100-222-1531, 100-222-1532, 100-222-1533, 100-222-1534, 100-222-1535, 100-222-1536, 100-222-1537, 100-222-1538, 100-222-1539, 100-222-1540, 100-222-1541, 100-222-1542, 100-222-1543, 100-222-1544, 100-222-1545, 100-222-1546, 100-222-1547, 100-222-1548, 100-222-1549, 100-222-1550, 100-222-1551, 100-222-1552, 100-222-1553, 100-222-1554, 100-222-1555, 100-222-1556, 100-222-1557, 100-222-1558, 100-222-1559, 100-222-1560, 100-222-1561, 100-222-1562, 100-222-1563, 100-222-1564, 100-222-1565, 100-222-1566, 100-222-1567, 100-222-1568, 100-222-1569, 100-222-1570, 100-222-1571, 100-222-1572, 100-222-1573, 100-222-1574, 100-222-1575, 100-222-1576, 100-222-1577, 100-222-1578, 100-222-1579, 100-222-1580, 100-222-1581, 100-222-1582, 100-222-1583, 100-222-1584, 100-222-1585, 100-222-1586, 100-222-1587, 100-222-1588, 100-222-1589, 100-222-1590, 100-222-1591, 100-222-1592, 100-222-1593, 100-222-1594, 100-222-1595, 100-222-1596, 100-222-1597, 100-222-1598, 100-222-1599, 100-222-1600, 100-222-1601, 100-222-1602, 100-222-1603, 100-222-1604, 100-222-1605, 100-222-1606, 100-222-1607, 100-222-1608, 100-222-1609, 100-222-1610, 100-222-1611, 100-222-1612, 100-222-1613, 100-222-1614, 100-222-1615, 100-222-1616, 100-222-1617, 100-222-1618, 100-222-1619, 100-222-1620, 100-222-1621, 100-222-1622, 100-222-1623, 100-222-1624, 100-222-1625, 100-222-1626, 100-222-1627, 100-222-1628, 100-222-1629, 100-222-1630, 100-222-1631, 100-222-1632, 100-222-1633, 100-222-1634, 100-222-1635, 100-222-1636, 100-222-1637, 100-222-1638, 100-222-1639, 100-222-1640, 100-222-1641, 100-222-1642, 100-222-1643, 100-222-1644, 100-222-1645, 100-222-1646, 100-222-1647, 100-222-1648, 100-222-1649, 100-222-1650, 100-222-1651, 100-222-1652, 100-222-1653, 100-222-1654, 100-222-1655, 100-222-1656, 100-222-1657, 100-222-1658, 100-222-1659, 100-222-1660, 100-222-1661, 100-222-1662, 100-222-1663, 100-222-1664, 100-222-1665, 100-222-1666, 100-222-1667, 100-222-1668, 100-222-1669, 100-222-1670, 100-222-1671, 100-222-1672, 100-222-1673, 100-222-1674, 100-222-1675, 100-222-1676, 100-222-1677, 100-222-1678, 100-222-1679, 100-222-1680, 100-222-1681, 100-222-1682, 100-222-1683, 100-222-1684, 100-222-1685, 100-222-1686, 100-222-1687, 100-222-1688, 100-222-1689, 100-222-1690, 100-222-1691, 100-222-1692, 100-222-1693, 100-222-1694, 100-222-1695, 100-222-1696, 100-222-1697, 100-222-1698, 100-222-1699, 100-222-1700, 100-222-1701, 100-222-1702, 100-222-1703, 100-222-1704, 100-222-1705, 100-222-1706, 100-222-1707, 100-222-1708, 100-222-1709, 100-222-1710, 100-222-1711, 100-222-1712, 100-222-1713, 100-222-1714, 100-222-1715, 100-222-1716, 100-222-1717, 100-222-1718, 100-222-1719, 100-222-1720, 100-222-1721, 100-222-1722, 100-222-1723, 100-222-1724, 100-222-1725, 100-222-1726, 100-222-1727, 100-222-1728, 100-222-1729, 100-222-1730, 100-222-1731, 100-222-1732, 100-222-1733, 100-222-1734, 100-222-1735, 100-222-1736, 100-222-1737, 100-222-1738, 100-222-1739, 100-222-1740, 100-222-1741, 100-222-1742, 100-222-1743, 100-222-1744, 100-222-1745, 100-222-1746, 100-222-1747, 100-222-1748, 100-222-1749, 100-222-1750, 100-222-1751, 100-222-1752, 100-222-1753, 100-222-1754, 100-222-1755, 100-222-1756, 100-222-1757, 100-222-1758, 100-222-1759, 100-222-1760, 100-222-1761, 100-222-1762, 100-222-1763, 100-222-1764, 100-222-1765, 100-222-1766, 100-222-1767, 100-222-1768, 100-222-1769, 100-222-1770, 100-222-1771, 100-222-1772, 100-222-1773, 100-222-1774, 100-222-1775, 100-222-1776, 100-222-1777, 100-222-1778, 100-222-1779, 100-222-1780, 100-222-1781, 100-222-1782, 100-222-1783, 100-222-1784, 100-222-1785, 100-222-1786, 100-222-1787, 100-222-1788, 100-222-1789, 100-222-1790, 100-222-1791, 100-222-1792, 100-222-1793, 100-222-1794, 100-222-1795, 100-222-1796, 100-222-1797, 100-222-1798, 100-222-1799, 100-222-1800, 100-222-1801, 100-222-1802, 100-222-1803, 100-222-1804, 100-222-1805, 100-222-1806, 100-222-1807, 100-222-1808, 100-222-1809, 100-222-1810, 100-222-1811, 100-222-1812, 100-222-1813, 100-222-1814, 100-222-1815, 100-222-1816, 100-222-1817, 100-222-1818, 100-222-1819, 100-222-1820, 100-222-1821, 100-222-1822, 100-222-1823, 100-222-1824, 100-222-1825, 100-222-1826, 100-222-1827, 100-222-1828, 100-222-1829, 100-222-1830, 100-222-1831, 100-222-1832, 100-222-1833, 100-222-1834, 100-222-1835, 100-222-1836, 100-222-1837, 100-222-1838, 100-222-1839, 100-222-1840, 100-222-1841, 100-222-1842, 100-222-1843, 100-222-1844, 100-222-1845, 100-222-1846, 100-222-1847, 100-222-1848, 100-222-1849, 100-222-1850, 100-222-1851, 100-222-1852, 100-222-1853, 100-222-1854, 100-222-1855, 100-222-1856, 100-222-1857, 100-222-1858, 100-222-1859, 100-222-1860, 100-222-1861, 100-222-1862, 100-222-1863, 100-222-1864, 100-222-1865, 100-222-1866, 100-222-1867, 100-222-1868, 100-222-1869, 100-222-1870, 100-222-1871, 100-222-1872, 100-222-1873, 100-222-1874, 100-222-1875, 100-222-1876, 100-222-1877, 100-222-1878, 100-222-1879, 100-222-1880, 100-222-1881, 100-222-1882, 100-222-1883, 100-222-1884, 100-222-1885, 100-222-1886, 100-222-1887, 100-222-1888, 100-222-1889, 100-222-1890, 100-222-1891, 100-222-1892, 100-222-1893, 100-222-1894, 100-222-1895, 100-222-1896, 100-222-1897, 100-222-1898, 100-222-1899, 100-222-1900, 100-222-1901, 100-222-1902, 100-222-1903, 100-222-1904, 100-222-1905, 100-222-1906, 100-222-1907, 100-222-1908, 100-222-1909, 100-222-1910, 100-222-1911, 100-222-1912, 100-222-1913, 100-222-1914, 100-222-1915, 100-222-1916, 100-222-1917, 100-222-1918, 100-222-1919, 100-222-1920, 100-222-1921, 100-222-1922, 100-222-1923, 100-222-1924, 100-222-1925, 10



Quadradar provides rapid accurate altitude of all aircraft in terminal area!

Provides greater safety through rapid coverage of all runways from one location

Gilfillan Quadradar provides rapid, accurate altitude, azimuth and range information on any aircraft, up to 50,000 feet. Quadradar provides further safety with rapid coverage of all runways from one location.

With Quadradar, pilots are informed of other aircraft in the terminal area, reducing collision hazards. Aircraft are located from either direction of runways without relocating equipment.

Quadradar provides terminal area surveillance, final approach, height-finding and arrival surface information. It is compatible with present systems to make for greater safety in final approach, air traffic control and high-performance climb-outs.



GILFILLAN QUADRADAR IS NOW IN OPERATION BY THE U.S. ARMY USAF, U.S. NAVY, U.S. MARINE CORPS, ROYAL CANADIAN AF, ROYAL DANISH AF, FRENCH AF, ARGENTINE NAVY, SWISS AF, ITALIAN AF, FINNISH AF, POLISH AF, ISRAELI AF, IRON CA, ROYAL AUSTRALIAN AF, FRENCH CAA, BELGIAN CAA, BOTTEN AIRPLANE CO. AND NORTHWEST AIRLINES. LOCKHEED ODOLUX, CESSNA, NORTH AMERICAN AND BOEING AIRCRAFT COMPANIES HAVE A JOINT OPERATION USING QUADRADAR AT PALMDALE FLIGHT TEST CENTER. OTHER INSTALLATIONS INCLUDE MACFITT NAB, AND AT THE SOUTH POLE.

EDITORIAL

Jet Era Problems

(Operational problems the airlines and their pilots can expect to face as they move deeper into the jet era—and how they may be overcome—were recently outlined by Maj. Gen. Joseph D. Calkins, Air Force Research Institute, based upon the broad base of knowledge and experience USAF has gained) (Due to its significance to the airlines, and to the aviation industry as a whole, Aviation Week is reprinting below major extracts of the speech made at a Washington meeting of the Aviation Union Association.)

Likely problem areas by phase of flight for civil flight, as based on Air Force experience during 1958, can be presented.

This brings me to the jungle . . . "It's what's up front that counts." Accident inducing factors are more critical in jet aircraft in pilot entry five area of flight in the Air Force, the first 200 hr. of jet time comprises the most dangerous area for transitioning pilots. Our records show that 60% of our jet bomber accidents in value pilots with less than 200 hr. of jet experience. One notable conclusion from studies on the subject is that thousands of hours of conventional flying time do not necessarily enhance the qualifications of a pilot as signed to a jet.

Flight planning or briefing is a big item in jet operations. In addition to the old-fashioned items, some additional weather phenomena are covered. Those in climb height of the hypoxia, temperature decrease from standard, high altitude turbulence and jet stream. Severe weather conditions—icing, visibility, temperature, pressure and winds—are almost thoroughly covered. There is no time to work at the end of the mile—because there is no fuel.

As it has always been in the past, the takeoff represents a very critical portion of the flight. The use of conventional checklists during take off, maximum thrust, speed and distance as well as weight or lift off speed is of extreme importance. Billboard type markers at 1,000 ft. intervals along the runway are absolutely inadequate, although they are the only means to assist the pilot at this time. Some sort of takeoff monitor is a must if we wish to avoid a catastrophe about. The best proof of this is the fact that B-47 aborted takeoff accidents are approximately 1800 a year.

One serious problem in the phase is anticipating when fuel exhaustion will be noticed in sufficient time to start engines and takeoff. Engine ground operating time at idle rpm, with a KC-135 approximately 18 gal. of fuel per minute. For visual information, a KC-135 burning 250,000 lb. at takeoff requires about 2,000 ft. of fuel to complete takeoff roll and accelerate to climb speed.

Variables in temperature, terrain and pressure altitude, plus certain inherent characteristics of the jet engine, are of vital importance to accurate performance planning for jet transports. Engine operating conditions which before could be generalized, now must be specific.

The biggest headline accident in aviation today are mid-air collisions. Although flying is safer than ever today and we can prove it, whether we measure our safety in terms miles or in hundreds of thousands of hours successfully flown, public opinion is formed by

every accident we have—particularly dramatic ones like mid-air collisions.

Mid-air collisions represent only 31% of all major accidents in the Air Force. It doesn't mean for one second to minimize the importance of mid-air collisions. I want only to repeat upon you the disproportionate effect this type of accident accidents has on the public mind in terms of the overall safety picture.

The reason most mid-air collisions ever occur is because the days of "see and be seen" flying are gone, and I'm glad to say, we in the Directorate of Flight Safety Research recognized this problem long before the famous Grand Canyon and Phoenix School disasters. In fact, we first proposed the need for an anti-collision device in aircraft collisions over five years ago, and both of these accidents could have been prevented had such a device been in existence.

Avoid from traffic control, there are two factors at work to make a collision possible, and these are two factors which every jet pilot—military and commercial alike—must know and respect. First, the almost fatalistic rule of head-on closing speed in high performance aircraft and, second, the human limitations of man whose reactions are appallingly slow when pitted against the rapidity of events that can occur during high speed flight.

One of the most important decisions the jet pilots make is when to let down. Fuel consumption in a jet engine increases astronomically in altitude decreases. Premature descent to low altitude or holding at low altitude imposes a severe penalty. After a long overwater or transcontinental flight, jet aircraft cannot descend to make a couple of passes at a field and then climb back to altitude and proceed to an alternate. The pilot must time, usually and accurate present and forecast time to another sufficient point to his arrival at his destination, early enough so that he can safely come in to land as directed in the case may be.

A recent study showed the Air Force experienced 235 major mid-air collisions which were not preceded by any conspiracy. Of this total, 195 involved jets. All except four of the 235 mid-air collisions occurred under contact conditions, and all except 15 occurred with visibility greater than three miles.

The primary reason for a short landing is poor air speed control on final approach, excessive rate of descent or late flareout for landing. The real work here being the difference between jet thrust and propeller horsepower. Part of the problem here is the time it takes to accelerate a jet engine from idle to high rpm and the fact that most of our thrust increase takes place in the last few per cent of rpm. One modern engine gets a 40% increase in thrust in the last 7% of engine rpm increase.

It is my firm belief that experienced crew under tests can contribute materially to the safety of military and civilian jet operations. I strongly urge that we avoid a continuation of justice through accident. Get the new engines and in so doing guarantee to every jet stage we civil reform that the best and only the best in man's up to date!

Jupiter Launch Precedes Primate Tests

By Cecil Bevelton

Washington—First biological loadings of primates into space directly are under way, and specifically designed for National Aeronautics and Space Administration's Project Mannequin on space program will be made late this year, probably early fall, from NASA's Pioneer 4 launch Research Station, Wallops Island, Va.

During the last 15 days of flight of two small animals on the flight program of 1959, in the nose cone of an Army Jupiter intermediate range ballistic missile will provide valuable preliminary data, the parameters of the launch will be designed to provide the specific stresses which would be met in put into space.

These will be found, NASA hopes, in a series of short ballistic flights from Wallops Island using Little Joe sub-orbital rocket boosters and instrumented capsules housing small primates, possibly ranging in size up to a chimpanzee (AWM Jan. 6, p. 27).

First Little Joe flight, which will be made without a primate aboard, is scheduled for late this summer in a test of the booster and instrumentation. If successful, it will be followed by three to four follow-on shots with primates aboard.

North American Aviation's Missile Division has a \$400,000 contract to provide NASA with seven Little Joe vehicles and a launch (AWM May 2, p. 27). "These for the Little Joe vehicles will be provided by improved Thaddeus Sergeant, control in pairs. Research models will be arranged under the Sergeant to provide a high initial boost.

Conventional Rising

The two four-man launchers flew down range from the Air Force Missile Test Center's Cape Canaveral, Fla., complex on May 25 to a maximum altitude of 300 mi. (AWM June 1, p. 37) briefly without acceleration forces of approximately 3g as compared with the 16 to 27g. Maximum altitudes are expected to experience. According to animal officials associated with the project, both came through without visible damage, although the latter of the two died four days later.

Death of the scores pound chimpanzee, designated monkey Able, was attributed to an adverse reaction to anesthesia which was being administered prior to an operation for the removal of one of three electrodes that had been inserted in his body for the measurement of physiological functions during the Jupiter flight.

Cdr Robert L. Halliday, chief deputy

commander of the Army Medical Research and Development Command, "think had responsibility for Able, and after the monkey's death last week, that a preliminary autopsy procedure absolutely no visible evidence of any injury was obtained that might be traceable to the space experience."

A more detailed autopsy of Able was scheduled to have been completed by late last week.

American Army physicians and their animal test structures had been experienced in a small number of times in the past. At the Army Medical Research Laboratory in Ft. Kean, Ky., where Able died, the monkey personnel had been applied to approximately 1,200 animals in about 700 monkeys without a fatality.

Able's partner on the flight—a Navy-trained squirrel monkey, weighing one pound and designated Baker—had been in good condition late last week at the Naval Aviation School of Medicine, Pensacola, Fla. As the truck had been moved from his table, but an anesthesia was used.

The 15-day flight of the two monkeys in a Jupiter nose cone, which also contained two additional two medical experiments being reduction efforts, was made on a "space available" basis during a regularly scheduled test firing of the Jupiter. The test was prepared by the Surgeon General of the Army and Navy carried out under NASA's sponsorship.

Possible extreme inhibition effects on the two animals apparently were negligible. Brig. Gen. Joseph H. McVinch, commander of the Army Medical Research and Development Command, said before Able's death that the primate had been placed in the whole body container at Walter Reed Hospital in Washington and that "the primate

40 count in this case is well within the normal range for a chimpanzee of his age."

Capt. Ashton Grubbs, research director of the Naval Aviation School of Medicine, described the physiological changes in the two monkeys in substantial from telemetry data during the flight as "extremely normal."

Capsule of the large Able monkey was instrumented to obtain and indicate back an electrocardiogram record, respiration, heart sounds, pulse velocity, finger blood vessels, body temperature, respiration rate and temperature and the pressure and relative humidity in the capsule.

Measurements on the smaller Baker supplied information on respiration, body temperature, capsule pressure and heart action.

Able also had been trained to participate in a behavioral response experiment as a test to determine the effects of weightlessness on reaction times and ability.

In the test Able was to have depressed a small hand lever in response to the flashes of a small red light inside the compartment fixed to cut in more quickly second. During a final pre-launch check of the capsule between it was found that the behavioral test unit failed with the other telemetry devices, and Army technicians decided to abandon the experiment.

Physiological Changes

Physiological changes recorded during the flight is described by Capt. Grubbs, included:

• Able's heart rate rose to "borderline flights" during the initial launch stage going from 140 to 175 per min., and then dropped back during the period of weightlessness to its lowest level, 74 per min. During re-entry, when the acceleration forces reached their peak, the rate jumped to 322. Normal heart rate for a chimpanzee between 130 and 180, Capt. Grubbs said.

• Baker's electrocardiogram showed a heart rate of 376 at lift-off which "basically varied until it hit peak, g, and then it went up to 140." During the coast g period, the heart settled back to its lowest level, 290. During re-entry, it climbed to 145, "a very good indication," Grubbs said "of total stress on the circulation system." Normal heart rate of squirrel monkeys covers a wide range—about 240 to 400.

• Able's respiration rate was 20 below lift-off and went up to 30 on launch "which isn't a big increase for a monkey." The respiration fell back to 28 during the weightless period but

For Mercury

basically reached 66 during the coast phase.

• Baker's respiration was 75 before launch, dropped on lift-off, then settled to between 75 and 90 during zero g. "It was looking along," Grubbs said, "and then on re-entry it got up to 118" for a period of 55 to 65 sec. before settling.

• G forces during launch reached a high of 15 on a "gradual rise from the lift-off" and an intensity but a peak of 3g for a period of less than 1 sec.

• Environment within the two capsules, Capt. Grubbs said, "remained almost at all. The trace was almost level." Highest temperature recorded in either capsule during the flight was 94°.

Auroral biological experiment carried in the Jupiter nose cone dealt primarily with the effect of cosmic rays, weightlessness and temperature on the fertilization process, cell division, cell respiration and metabolism.

In the test, two million eggs and sperm were analyzed in three separate vials within 10-sec aluminum crates in which the fertilization reaction was triggered before and during peak acceleration.

One vial contained unfertilized eggs, another eggs that were fertilized by a triggering mechanism during acceleration, a third, unfertilized eggs that were activated before launch. In the latter, the fertilization process was halted by a fluoride triggered during deceleration.

Dr. Douglas Wolf, chief of NASA's Biologic and Life-support systems, said from these tests and later experiments using more sophisticated organisms will help determine the effect of space phenomena on the complete life cycle of a species and whether, after fertilization, the complete life cycle can be carried through "These 6." Dr. Wolf said, "considerable doubt that certain species can carry through their complete cycle in this environment" he added.

"In plants, for instance, it is quite certain that the plants that have grown in a 1-g field and developed through the first of years, would not produce normally in the environment."

Biological Study

The nose cone also contained a bio-manifest package developed by the Army Medical Research Laboratory at Ft. Rucker consisting of four cylinders, each approximately one and one-half by four and one-half inches long and each containing a specific biological system. The four capsules and the support of the test, it added by Dr. James G. Kerwin, Jr., of military laboratory was:

• Cylinders containing 25 cells of human



JUPITER nose cone (short) around monkey Able in unaccompany position (inset), just down during launch phase as its back would face earth in re-entry and absorb acceleration forces.



AGSKEY Baber was inserted in Jupiter nose cone. Altimeter did automatic altitude temperature.



whole blood." The decrease of the plasma conditions associated with high acceleration or acute deceleration, the adverse plasma conditions associated with normal flight, if it had any effect on the blood elements of the blood. This might be of some importance in situations of remote transport of blood for transfusion.

• **Tissue cells and red cells.** A single form of bacteria, were housed in a second cylinder, such as a separate cell. The matter was contained within a semi-solid environment medium to keep it constant during the time of the experiment. Later, upon its return to Ft. Knox, the organisms black were to have been not and not in media added so that its growth could be followed at the laboratory.

• **Plant material in the form of onion tissue and avian seeds** was carried in a third cylinder. Purpose of the experiment was to try and determine possible cosmic ray particles on the tissue by germination in suitable tests or by placing the onion tissue in a solution of filtered radioactive chloride.

• **Fourth cylinder carried approximately 100 feet of paper container** as a small piece of filter paper in a plastic vial. They will be used to determine how many bacteria into which filter and possible modifications of the container. So that the will be used for possible modifications or changes in their offspring.

Data is still being reduced on both the avian seed test and the Army bio medical plan.

Because of its position in the center and high in the Jupiter nose cone, the

Ullie capsule with the remote mode had to be installed approximately 70 in. before launch to permit the positioning of other components located below it.

Baker was more fortunate. Its rest, which penetrated across through a post, coupled with the fact that it was too small farther down in the cone, allowed it to remain outside until ten hours before launch.

Monkey Alike rested in a semi-separate portion and fell down during the free-fall phase so that its back would face the earth during re-entry and absorb the major acceleration stresses.

In capsule, approximately 6 in. long, audiotape temperature control, pressure control, oxygen regulation system and a bag of barium pellets to absorb carbon dioxide.

Oxygen was fed into the capsule from two bottles pressurized to about 1,500 lb. Pressure was fed into the unit by a sensing venturi which allowed oxygen to enter in the pressure inside the capsule dropped. Padded couch can hold a 100 lb. glass bottle containing shell packed with a polymer, these substance approximately one-half inch thick.

The capsule designed for monkey Baker, who also made the flight being down at launch and is a separate system with launch down to, not similar to the one developed for Gordo, the small squirrel monkey who made a similar flight, but short, in the nose cone of a Jupiter last November (AW Dec. 12, p. 15). Gordo, however, was not recovered.

The capsule, measuring 9.35 x 12.5 x 6.75 in., contained 650 cu. in. of space available for the monkey, animal and recording equipment and weighed a total of 23.5 lb.

It was insulated with fiber glass and rubber, and oxygen was furnished from a flask equipped with a pressure-sensing valve.

A metalhead shielder released oxygen moisture from the atmosphere within the capsule and, as in the case of Alike, the system contained a bag of barium pellets for the removal of carbon dioxide.

The recovery package used in the firing was developed by Cooke Laboratories, of Chicago, for the Army Biological Medical Agency. Its operation, deployment of the package is triggered by a deacceleration switch.

At a certain stage of the deacceleration the back plate of the nose cone is blown off, and a mechanical beam opens a parachute. At this point, two small parachutes also are ejected from the sides of the cone to aid Navy search teams in locating the cone. Three seconds later, a second parachute is ejected to aid in the landing process.

Just before hitting the water, a large red balloon is expelled, carrying with it a light and a radio antenna for the recovery team. Once the balloons hit the water, the antenna is ejected and begins to transmit continuous signals that can be picked up by search aircraft for either to the surface craft waiting to make the recovery. The nose cone itself is attached to the balloons by cable.



DISCOVERER payload is designed to be attached by Fenchel C-119 of 6556th Test Squadron, Hurler AFB, Hawaii, as shown in drawing. Aircraft will house on recovery capsule's radio beacon which begins transmitting as parachute opens at about 51,000 ft. Below: a positive space capsule is launched into a C-119 during a positive recovery trial over the Pacific Ocean.

Discoverer III Fired, But Fails to Orbit

Vandenberg AFB, Calif.—Discoverer III blasted off from here last week for what was to have been the country's first attempt to collect biological data on orbital flight.

The experiment was assigned a full size, however, when, 35 hr after launch, all efforts to track the second stage vehicle had failed. The Thor booster carried the second stage to orbital altitude, separation occurred and the Bell Huzler engine of the Lockheed-built second stage fired, but orbital flight was not attempted.

telemetry data was received at the launch site and by the downrange tracking vessel, but Air Force officials said that when other tracking stations did not acquire the satellite, it was assumed that it entered the atmosphere prematurely and was incinerated. They did not believe Discoverer III achieved sufficient velocity for orbit space.

Four laboratory-bred black mice in a 160-lb recovery capsule were to have provided the first U.S. biological data from orbital flight. Primary interest was in the effect of cosmic radiation. Black mice were chosen because cosmic radiation exposure can cause a noticeable color change in their pigmentation.



Lockheed JetStar Prototypes in Flight

Lockheed Aircraft's two prototype JetStar aircraft are photographed together in flight for the first time over northern Georgia. Production models of the four-engine jets are being built at Lockheed's Georgia Division at Marietta, Ga.



Doak VZ-4DA, idea of vehicle from a member of Lincoln AFB, Calif., to begin transition experiment. Two winged dotted line on fuselage from a single (forming 75) surface capsule mounted in the fuselage. Radar is behind the cockpit.

Doak VZ-4DA VTOL Demonstrates Conversion Cycle



Fuselage tilted forward to begin the conversion cycle. Degree of tilt is marked by white lines on the inboard side of the left wing fin. Gross weight of the research vehicle in this position was at maximum-14,000 lb.



The aircraft reaches forward flight with the fin stabilized completely through 90 deg. Conversion has been made successfully at gross takeoff weights from 3,000 to 6,000 lb. Fuselage tilted forward in the lowering configuration.



Boost in Radar Tracking Range By Five-Fold May Be Possible

By Philip J. Kloss

Washington—Five-fold increase in the radar tracking range of radar, which should extend to areas to distances of up to 10,000 mi. against small targets and up to 25,000 mi. against large targets, now appears possible. Dr. H. C. Wits of Lincoln Laboratories reported last week during a conference of Armed Forces Communications and Electronic Systems.

In order to track deep space probes, however, the vehicle will have to carry a small radar beacon. For such beacon-equipped spacecraft, Wits said, radar should be able to track a vehicle to distances of 400-500 million mi. Most likely operating frequency for the tracking radar will be in the 300 to 1,000 mc region, perhaps centered near 500 mc.

Problems of detecting tracking and identifying unknown satellites will prove more difficult, Wits continued. He described several possible configurations of large earth-based radar which could detect satellites and make up to 25 measurements of satellite altitude, direction, position and range during a single pass. Using pulse radar techniques it should be possible to sort out and keep track of up to 16,000 random space objects, said Wits, Wits said.

Lincoln Laboratories studies of the satellite detection/tracking problem are sponsored by Air Force's Air Research & Development Command. Under sponsorship of the Advanced Research Projects Agency, ARPA, Dr. Wits said a blueprint for a satellite detection/tracking network required to handle as required "space exploration of the future, as well as integrating present facilities for an intercontinental capability.

Col. Lawrence, head of ARPA headquarters, and the agency hopes to have approximately \$10 million a year by the end of 1960 that it is ARPA, funds to continue its investigation of the problem and to sponsor required state-of-the-art developments. Presently, the operation of the space surveillance network will be transferred to a USAP operating command but the change has not yet been made.

National Aeronautics and Space Administration's first experimental passive communications satellite, scheduled for launching in early 1964, will operate two-way radio propagation both between California, Calif., and New Texas using a frequency of 2,000 mc. For the first time, transmission at 1,000 mc for the radio-voice transmission, NASA's Lincoln Lab told the AFCEA conference. This also discussed the possibility of setting up a "chaff" radar around the earth which would serve as a defense against the radar signals. Elsewhere, he said that considerable work and work are required to establish the feasibility of this approach.

One reason that the Defense Department is pushing development of active communications satellites, while NASA develops passive types, is that the latter require only relatively small earth-based antennas and transmitters as compared with those needed for passive communications satellites, ARPA's Dr. Samuel Barlow said. This makes it easier to handle such earth-based antennas and transmitters to launch them to make them as valuable to launch them, Barlow said.

To make active communications satellites reliable, consistent to ensure jamming requires that the active satellites be equipped with a large number of extremely broadband antennas. A 100-1 antenna in bandwidth can be obtained at the antenna of a "homing" satellite at 21-400 mc. Although, can be continuously transmitted in that it is used at a wide range of frequencies, it is a non-directional antenna, Barlow said. For ground-to-space communication, with the satellite in a 5,000 mi. orbit, a 100-1 gain in bandwidth can be achieved through continuous operation of the active antenna, Barlow said.

In 1962, large radio antennas should make it possible to receive transmitter power of deep space pulse vehicles in a factor of 5,000 that of a 100-1 gain in 100 watts. Dr. Wits said that the problem of receiving power of a 100-1 gain in 100 watts is the minimum two hundredths that can be transmitted from a laser probe. Barlow pointed out that information transmitted greater than 30 mc should be possible for a laser vehicle, with a figure of 0.3 mc for a laser probe vehicle.

Cost of constructing active probes around a vehicle in space vehicle means active cells, at current prices, can run into millions of dollars. Dr. Nathan Sessler of ARPA told the conference. Cost of producing 100 watts electric power, continuously, using silicon cells that do not intrinsically accept themselves to face the sun, can cost \$1.8 million of the vehicle in its earth's shadow, 10% of the cost, at the time, said Wits, said. However, he said that the price of silicon cells is coming down.

Sessler reported that ARPA, NASA and the military services are investigating the complete spectrum of techniques for generating electric power, ranging from fuel cells to solar cell arrays operating with heat engines from nuclear cells to thermoelectric converters. He said that ARPA is studying power sources to be using ranging up to 10 mc.

Studies include 30 ft. diameter solar collectors, capable of being linked up in arrays, which would be capable of collecting and focusing up to 100 lb. of solar energy for generation of 25 kw of electric power.

Studies include 30 ft. diameter solar collectors, capable of being linked up in arrays, which would be capable of collecting and focusing up to 100 lb. of solar energy for generation of 25 kw of electric power.

News Digest

Follow-on contracts totaling \$17,151,000 for production of Ames Laboratory working model rocket have been awarded to the Martin Co. of Omaha, Neb., by Ames and a large amount of the program is in the making at the SRI, Calif.

Space Recovery Systems, Inc., of El Segundo, Calif., has a contract for the recovery system to be used to transport with the crew escape capsules on North American 7-100 and 8-700 Mich. systems. Systems is consisted of electronic components which are incorporated into the capsules, making it easier to locate ejected crewmen.

Ames Ordnance has awarded Ohio Matheson Chemical Corp. a \$500,000 contract for research and development of a new solid propellant for Nike Zeus. The Nike Zeus propellant is similar to a new solid propellant under study for the Nike Ajax, according to the company, and is not related to Ohio Matheson's high energy boost fuel work.

Shaw-Wick & Hamilton's SC-1 vehicle and landing air vehicle test unit, made its largest flight—on 100 ft. at the company's Biller, North Carolina, inland airport. Aircraft hovered 100 ft. above the ground and flew forward for 100 ft. at 30 ft. altitude.

Early warning radar contract for North Atlantic Treaty Organization in Britain has been awarded to Marconi Co. of London, England, by the Government of Great Britain and Compagnie Generale de Telegraphie et de Telecommunications, France. The contract is for \$10.5 million for the radar system, and installation of all equipment in NATO ships. Major parts, about \$1.8 million, sent to the British firm.

Western Air Lines' first Lockheed Electra turbo-prop transport was delivered last week. Flight from Los Angeles to London, Calif., to the Western's Los Angeles base at International Airport last week.



UNITED's Douglas DC-5 jet transport's seats (left) have built-in armrests, such as the standard old buses, seating long in upper and lower aisles where desired. At right is the friendly passenger lounge.

United to Begin DC-8 Flights Sept. 18

Los Angeles-United Air Lines, entering the jet era mass market before competitors, took it will order no less than 40 flights from the delta, and a day is needed for the Douglas DC-8 since it takes time to get the aircraft to the airport, according to William A. Peterson, United's president.

Peterson accepted delivery of United's first JT-3C (717) powered domestic jet transport from Douglas Douglas, Inc., at an expense here last week. The airplane will be operated on a point-to-point schedule, for free training and route familiarization.

Concerning United's jet schedule, Peterson said:

• **Final transcontinental service** will start Sept. 18, following confirmation of the DC-8. The line will inaugurate jet service with at least eight DC-8s per month. Daily flights will be scheduled and easily meeting will be accomplished.

• **Casual service** between Los Angeles Sea-Tac and New York will be started on October 10. Service will be on a daily basis, with one flight to New York and one to Sea-Tac. There is a single time to send a flight to Sea-Tac/Seattle and return, thus increasing the airplane with return rate and making service to these areas easier than the line needed for more airplanes.

• **Transpacific flights** to Honolulu will be started Jan. 21, 1960, using the DC-8. The aircraft will be operated on a point-to-point basis, for free training and route familiarization.

Concerning United's jet schedule, Peterson said:

• **Final transcontinental service** will start Sept. 18, following confirmation of the DC-8. The line will inaugurate jet service with at least eight DC-8s per month. Daily flights will be scheduled and easily meeting will be accomplished.

United Considers DC-9

Los Angeles-United Air Lines is "very interested" in Douglas' proposed DC-9 medium-range jet transport, and would definitely buy the airplane should Douglas decide to go ahead with the project. United President William A. Peterson declined last week. He added that although United remains very open to a contract to DC-9, it will remain Douglas as "the aircraft" in the interim.

Proposed DC-9 would use a scaled down version of the Pratt & Whitney JT3D turbofan (7000 lb. thrust), or possibly a British Rolls-Royce powerplant of the same thrust class, he added.

Estimated to be an airplane to carry about 70 passengers, able to operate on runways of 300 to 400 ft. in up to 900 ft. runways, with a thrust power weight approximately 170,000 lb., Peterson said.

Anticipating that the line has a medium-range airplane in its Boeing 720, Peterson pointed out that there are some airports which United serves where other could very well take to generate traffic in support perhaps their flights daily at a 50-passenger plane, where line could not be able to support the required number of flights of a 120-passenger aircraft.

However, had facts on reasonable utilization should be 540, Peterson said. The DC-9's introduction thus far in the use of the DC-8 class, Peterson said. Peterson added that the DC-9's introduction is a firm project could result in lower rates for the 720 than are now planned.

plans, owned by Pratt & Whitney JT3D engine.

First of the big DC-8s will be delivered in 1960, and will be introduced on the Honolulu flight immediately, Peterson indicated, while the first DC-8s on that line will be operated about 1961. The airplane enters service.

United will have 14 DC-8s delivered by the end of 1959, Peterson said. Noting that United has been planning to acquire the aircraft for introduction of the jet, Peterson said United's flight crew started training in Los Angeles last September. In addition, he added that present United plans specify some 20 ft. of operation time followed by 30 or more hours' flight time.

Questioned concerning the forthcoming jet transcontinental speed controls which are slowing up among jet operators, Peterson said, United is not at all concerned in the DC-8s to come.

United is not at all concerned in the DC-8s to come, he added. He added that, even if United personnel feel that at present not enough is really known of operating jet transports in the day-to-day use of high Mach numbers, and that United presently is planning to stay back somewhat from the landing March month.

Peterson also announced the new class of aircraft additional Boeing 720 medium-range jets, in addition to the 11 ordered earlier in December, 1957. Deliveries on the 15-plane order will start in 1958.

The United president and United has completely financed all jet purchases for its immediate, including the seven new Boeing 720s, but indicated that additional financing would be required and would have to be arranged in order to sign contracts for more airplanes, such as the Douglas DC-9 or Boeing's projected model 727.

United still is studying Lockheed's Electra turboprop airplane, Peterson said, but has decided Comair's 880 and

will get transports. According to a statement by Peterson, United's losses during 1957 jet aircraft to its fleet by 1967 and will of course, when some point-to-point equipment. With 40 DC-8s currently on firm orders, plus Boeing 720s, Peterson said the jet will make for higher jet of the DC-9 or Boeing 727 than could run as high as 10 airplanes into a five-year period. This would leave some 30 to 35 jet airplanes to be ordered, with the type probably dictated by whatever need appears greatest at the time.

The airline currently operates 164 piston-engine transports, Peterson said, adding that while no planes are scheduled to leave for piston-engine planes with more, in their hands, he focuses on great barriers to disposing of surplus transports of this type except for the DC-9.

Concerning the general business outlook and financial picture, Peterson and United figures indicate that overall this year is quite of competitive spirit, but not as good as United's situation in 1957. However, he is not at all concerned that some surplus transcontinental flights had been cancelled.

But between New York and Chicago, he declined, United seems to be holding its own very well. Peterson said that the company, Peterson said, currently are judged by United's operations at SFO for the New York-Los Angeles line, 57 for the Chicago-Los Angeles line, and 53 for the New York-Chicago. While none has been set up for Los Angeles, a figure between 53 and 57 will probably prevail—perhaps 55.

Peterson pointed out that the surplus would go for the jet operators. He added that the company is making an overall 12% increase. He indicated that a CAA examiner recently noted that the jet schedule, which was increased 10%, leaving 12% to go.

Requirement for the 12% increase according to Peterson, is the situation which arises when airlines add new aircraft capacity and are required to. The airline industry, he pointed out, the shareholders as stock buyers want a certain return for their money, and he believes the additional 12% would provide the necessary margin.

In addition, Peterson said, he believes the current debt capital rate of the airline, about 60% debt against 40% equity, should be reduced.

For the future, Peterson said, the airline is not at all concerned that it will be twice that of 1957. The company anticipates that because will increase by 14% the first year, jet air is added, and will be of a fairly sharp increase per year through 1965. Of this, Peterson said, United expects to gather approximately 17% of the total.

University Study Sees Dim Future For Surplus Piston Plane Market

By Robert H. Cook

Washington—Northwestern University Transportation Center report predicted that work that the value of used piston-engine aircraft will drop to about "scrap" levels by the end of 1959. The report, drafted after a one-year study that attempts to forecast the need for piston-engine aircraft for the next 10 years, but does give the airline and used plane dealer.

The study predicts the high end of the surplus price of piston engine planes against the transition of many airlines to jet transportation based on a forecast of world traffic, operating costs of the different aircraft and the supply of transports on hand. University researchers adopted a "basic program" technique to arrive at their conclusions and showed the application of the method to predict the "price of a capital asset" as a "new objective."

Two of the largest and most difficult in the country, Frederick B. Aver & Associates, Inc., and General Aviation Leasing Corp., trained the analysts "block" and "unblock" and questioned the source of the study data.

Average estimated that the total surplus of piston engine aircraft in the North America market of 1957 would be 10,000. The DC-8 and DC-7A in planes for in excess of three years by the North American study, estimated that the report falls on the current price being reported on surplus, and that it is accurate the future disposal potential for such assets throughout the world.

Both the airline and dealer markets for it is a rapidly, especially in the case of the surplus market, an annual basis for a predicted period as far away as 1965, which the aircraft study attempts to do.

After extensive point out that a recent study of the problem by United Research, Inc. makes good estimates of used aircraft values only as far as 1951 based only on an annual percentage change in value.

Of greater importance, however, is that United's study of the foreign market for second-hand planes indicates a need for 450 medium and medium-large transports within the next three years. United Research estimates that there are currently 455 medium aircraft in U.S. carrier inventories at this time and that to fill the anticipated foreign need, 95% of this total would have to be added within the next five years.

Involving 10 years of study of piston engine aircraft plus the changing VFR market, the country's Transportation

Center forecasts that through 1965:

• **Recent turbo-prop aircraft**, such as the Douglas DC-7 and Lockheed Super G, L-1049G and North American NA-40, will undergo a four-point drop and may be at or near "scrap" value as early as the end of this year, or at least by the end of 1960. Boeing Stearman's also were included in this category. The report estimates a current value of \$240,000 for the DC-7, 7B and 7C by the last quarter of 1959. The Lockheed L-1049 also was included in the low-price group by the end of this year at a current value of \$250,000.

Some low-price aircraft, such as the DC-6 and early models of the Cessna and Super Constellation, will decline at a slower pace but will reach scrap level by the end of 1959 or early 1961. DC-6 prices were estimated at a \$120,000 by the end of 1959, with the Lockheed at \$100,000 for the L-409 and \$120,000 for the L-1049.

United Research places a \$145,000 as initial price tag in the latter aircraft by 1961.

• **Douglas DC-6s** and DC-6Bs will remain above scrap prices beyond 1965 although their value will decline. Expected prices quoted by Northwestern were a \$175,000 average for the DC-6 by the end of this year and \$70,000 in 1965.

The DC-6B will bring an average of \$80,000 by the end of 1959 and only \$70,000 by the end of 1961. The report said.

• **Recent surplus** piston engine aircraft, such as the DC-3, will be valued at \$175,000 in 1961.

• **Values** of surplus 700 series will decline slowly with an expected average value of \$470,000 at the end of this year and \$230,000 in 1965.

• **Cessna** and Martin transports will remain relatively high through the period with the Cessna 340 bringing \$100,000 by the end of this year and the 340 and 440 series \$700,000. Cessna will drop to \$175,000 and \$70,000 by 1965 with Martin 404s estimated only \$160,000 by the end of 1959, and Northern entry.

• **Douglas DC-3s** will remain in service but at a price near or at the scrap level throughout the entire period.

Key to much of the price of most aircraft phased out by airlines taking jet deliveries is the "scrap" value, the report said. The "scrap" value is the value of the aircraft as a scrap metal.

He added that a high percentage of piston engine aircraft will be needed well beyond the five-year cutoff of the Northwestern study.

He added that a high percentage of piston engine aircraft will be needed well beyond the five-year cutoff of the Northwestern study.

He added that a high percentage of piston engine aircraft will be needed well beyond the five-year cutoff of the Northwestern study.



Leading airlines order

BOEING TURBO-STARTERS

Major airlines, including Delta, Northwest Pan American, TWA and United, have already ordered Boeing Turbo-Starters to provide fast, economical starts for large jet and turbo-prop engines.

Two quiet and versatile Boeing units, backed by thousands of hours of rugged field service, supplies or to start the largest jet and turbo-prop engines—quickly and economically.

The Boeing Turbo-Starter also provides air for ground operation of alternators, pneumatic systems, and for checking radio air conditioning and pressurization. It can be used to remove snow and ice from aircraft and related equipment.

Power is provided by the Boeing 502 118 psi turbine,

which incorporates all the advantages of Boeing's 15 years of experience in gas turbine research, development and production.

Installation is in built-in panel trucks for maximum mobility. For complete details, write Mr. J. C. Anderson, Sales Manager, Industrial Products Div., Boeing Airplane Company, Seattle 24, Washington.



Minetti's Dissents Oppose Higher Fares

By L. L. Doty

Washington—Recent dissent of G Joseph Minetti on the Civil Aeronautics Board's Air Carrier Market and Fuel Cost (AW May 25, p. 36) has focused industry attention on his Board membership as the latest of the great dissents.

Since the first of the year, Minetti has filed a total of 22 dissents covering by a 25 page document that carefully challenges the majority's legal findings on the market and fuel decision. In the second part, two other members of the Board have stood out as quantified dissenters: Harold A. Jones, a Board member between 1948 and 1953, and Joseph P. Adams, 1953-1956.

Dissension Follows Pattern

On the surface, Minetti's mood of dissension might suggest a new era of independence toward the Board and its legal decisions. His dissensions, however, follow a pattern that reflects more basic ideas in his underlying philosophy on regulatory matters.

In addition, while his dissensions reveal a strong interest in economic factors, his frequent failure to vote part in such certification cases suggest an equally strong lack of interest in route construction.

Since January, he has taken no part in route cases that have been decided by the Board. Whatever his reason for abstaining in these cases, they are the only ones that he has voted in which he is so noted as not having participated.

He did vote in the recent Pacific Northwest Local Air Service Case but took no part in the significant Chicago-Milwaukee-Twin Cities Case (AW June 3, p. 48) which drew considerable dissenting opinions from Vice Chairman Glenn Gurney and member Louis Blumenthal.

He did not vote in the Inter-Midwest Case, the Kalamazoo-Grand Haven Air Line Certificate, Great Lakes Southwestern Service Case opinion and vote in the first and second supplemental opinions in that case.

Last year, he took no part in the original decision in the South States Case, Great Lakes Southwestern Case or the investigation of service to Wisconsin-Salem and Greenbush-High Point. He did participate in the St. Louis-Southwestern Service Case but filed a dissent. He voted with the majority in the Dallas-West Coast Service Case.

Minetti also added to his record a dissent against a Board opinion granting a certificate to Trans-Texas to serve Vietnam and Saigon-Chester.

However, the vast majority of his dissensions against the majority appear to fall into four chief categories which would indicate he holds these positions as reasons for his dissents.

- **Opponent of any fare increases or the addition of surcharges.** The dissents in this area may provide some hints as to how he will vote in the General Passenger Fare Increase.
- **Champion of common charter flights.** Minetti's dissents against the majority decisions denying exemptions for certain charter flights might be expected in this type of issue as an essential lack of international transportation.
- **Opponent of high subsidies.** Minetti is a consistent dissenter against any aid of route or investment for local

service routes that is higher than 5% until a decision on the Local Service Carriers Rate of Return Case is reached. His recent dissents against the carriers' 95% rate of return are even less than for this year's rate of return recommended for airlines in the recent carriers' profit decision on the bus case.

• **Sensitivity to arbitrary violations.** It is noted in his dissents Minetti has a background in special assistant to the U. S. attorney general in the Antitrust division.

On the fare issue, Minetti opposed a slight upward fare increase of international flights filed by the International Air Transport Association for the winter hemisphere. His dissent against a Board decision to suspend a tariff ruling for reduced rates between Seattle-Portland and Anchorage-Chester, Alaska.

He supported the 25% reduction in "full-cost" check rates between Boston and Miami which Vice Chairman Gurney was opposed on grounds that the rates were not "sufficient to cover costs of the service rendered."

He dissented against the majority's approval of a jet subsidy on first-class domestic flights because the General Passenger Fare Investigation indicated "no industry anticipation that such costs for jet aircraft will be appreciably lower than current unit costs for piston driven aircraft."

He also noted that the surcharge, coupled with other fare increases and adjustments would increase rates 17% above the fare level effective prior to January, 1958, and he expressed that dissent with the 15% average fare increase suggested by the industry in the fare case.

In the route case, similarly Louis Blumenthal not only supported the first-class jet subsidy but said he was in a minority with a surcharge should not be applied to route traffic.

Later, the Board approved surcharges for both types of travel.

Charter Advocacy

In the recent charter field, a majority ruling denying an exemption to operate a charter may dissent (inability to be expected to show a dissent from Minetti). Since Jan. 8, he has filed no such dissenting opinion nor liberal treatment of charter requests. In several cases during the past year, his dissensions have resulted in a reversal of the Board's decision.

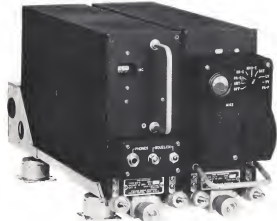
Last month, Minetti filed a dissent in a trans-Pacific charter flight ruling to initiate the Board. The requested exemption for the flight was



G. JOSEPH MINETTI

Washington—G. Joseph Minetti, 52, was appointed to the Civil Aeronautics Board in President Eisenhower in 1956 as a member of the Dissenters' Committee on the Bureau Board. Between 1954 and 1956 he was a member of the Post and Maritime Board. Previously, he had practiced law in Brooklyn with the firm of Dunlop, Delaney & Minetti and served as a member of the New York City Board of Transportation and as executive assistant to the Deputy Mayor of New York.

From 1947 to 1950, he was commissioner of the Department of Marine and Fisheries of New York City. During World War II, he served in the U. S. Army in the Counter Intelligence Corps in Europe. He has served under three U. S. attorneys general as a special assistant to the Attorney General. A native of Brooklyn, Minetti studied at Fordham University and St. John's University of Brooklyn where he received his degree.



the most popular pair since Wilbur and Orville



Already in wide use by airlines and business fleets, Collins SLK-2 Receiver and TLL-7 Transmitter are the overwhelming choice of the airlines in the new jet and propjet transports now flying or under construction. This popular pair meets jet age demands for increased reliability and simplified operation in reduced size, lightweight airborne equipment.

The Collins SLK-4 Airborne VHF Receiver covers the 108.0 to 251.00 mc range, providing 880 crystal-controlled channels for VHF communication, VOR, LOC and TVOR reception. The companion unit, the TLL-7 VHF Communication Transmitter, provides 880 crystal-controlled channels with 50 kc spacing to the 118.0 to 151.00 mc range, 25 watts output.



COLLINS RADIO COMPANY • CENAR RAPIDS, IOWA • DALLAS, TEXAS • BURBANK, CALIFORNIA

directed by the majority because of alleged misrepresentation made in 1937, prior to the application for the charter in question.

Moretti, in his dissent, wrote that since the current misrepresentation is so more material than the past, it does not detract from the charter worthiness of the group. He added:

"I am puzzled, however, that the Board should take this time and method of achieving the charter of its dissolution with 1937 representations. The matter should have been discussed and decided when it arose in 1937."

In his dissentance against the grant of a 91% rate of return on investment for local service and helicopter contract, he has been joined by Electric on an economic grounds. Moretti's reasoning for these dissentances made visible to this:

"I cannot agree to allowing this excess 9.95% rate of return on investment prior to a resolution of first priority in the pending Local Service Charter Rate of Return Investigation."

His philosophy on subsidy is summarized in the extent from a dissent in a New York Authority order:

"Proper exercise of our stewardship of public funds dictates that we provide helicopter operation with a higher subsidy rate of return only where an evidence, foundation establishes the necessity and propriety of doing so."

Moretti also dissented against a new joint operation in the Delta-Chicago & Southern Regional Mail Rate Case and wrote that the amount of mail pay-

ment to C&S should be reduced by \$1,147,000 rather than the \$1,795,000 fixed expense by the majority.

The consistent character in any move which was made the probabilities of the contract have manifested in his dissentance against a majority order authorizing Delta Air Lines to sue with other carriers for the purpose of causing the withdrawal of fuel to non-dollar amounts. And in his dissentance to the San Carlos Mutual Aid Fund case, he acted to prohibit its dissolution in the aid agreement by voting.

"Such questions as above present serious complications agree to short-term recovery. Sharing profits with a competitor like sharing profits for first-class fares. So Moretti is actually in conflict with the concept of vigorous competition between rivals. The carriers have been authorized to compete with, not subsidize, each other."

It is this strong stand against the majority opinion in the counsel and one that has spotlighted Moretti as an expert voice. In no instance, though, did the dissentance, does Moretti state that the majority's findings are flawed or that their decision actually violates the Railway Labor Act.

In his conclusion, Moretti calls for a withdrawal of the agreement "in advance to the public interest." Further, he writes that "we cannot approve this agreement as not in violation of the Federal Aviation Act, the Railway Labor Act, or in the public interest in either, if it permits, encourages or re-

sults in carrier activities which violate carrier statute" and then adds:

"In the absence of information responsive to the more questions arising under this agreement, we must drop point A."

However, he fails to consider in his criticism of this agreement. The committee he writes that it suggests criticism on labor and is "precluded in a proposition" in support of the Railway Labor Act. He charges the agreement is "contrary to the objectives of the Railway Labor Act" in that it suggests compulsory membership, requiring sufficient employee consent and takes relief which an economic force for good faith bargaining.

He notes that agreement "in discussing economic welfare unless employees accept it" and all Railways Board findings around the Railway Labor Act's definition plus in a second which, from an employer's point of view, is just as effective as the elimination of the statute.

Moretti is equally critical of the Board in the dissentance and writes:

"How, in spite of a panel here in decision that the agreement is repugnant to the purpose of the Railway Labor Act, the majority has granted its approval, not on an insufficient record, but in the total absence of any contradictory record. In addition, this decision is approached by the fact that board counsel, around the rule spokesman for the public interest, has neither participated in oral argument nor filed a statement of position."



Boeing Completes 50th 707

Fifth Boeing 707 off the production line at Renton, Wash., is American Airlines' 15th 707-420. Previous deliveries of the jetliner transports have been to: Eastern Air Lines, 14; Continental, 5; Delta, 1; NAC, 1; Braniff, 1 and USAF, 1.



FLIGHT demonstration in Europe of the Viking Vanguard turboprop transport are being supported by alloy ground presentation.

Vanguard Tours Europe in Sales Drive

Weybridge, England—Vickers has launched a slick, comprehensive sales presentation in Europe for its Vanguard turboprop transport.

Each presentation is based on a flight demonstration with the Vanguard and a full day's ground session backed by a film and slides. Presentations are being made in Germany, Belgium and Italy, the aircraft returning to base each day.

The ground presentation is divided into four sessions: the morning session being concerned with a detailed survey of the engineering and introduced by a film showing design, production and wing handling details. This session also includes a flight test report.

The afternoon session is devoted

to a complete detailed analysis of the economic and operational features of the aircraft.

The thespian and well rehearsed character of the routine was made evident to American Weybridge during a run through of the presentation during the annual Vanguard operators conference at Weybridge.

Each presentation is introduced by a full director of the program. Spoken as the sales team and all designers with flying experience. They stick to a detailed layout, presented according to the routine, in which the presenters take place. The operational statistics and graphs are presented around the operational basis of that country. Spoken as the director to suit different

audiences. Both session were held and are being discussed with the aid of a Vickers club, present which is currently in the process of being set up at about one-third the price.

The presentation seeks to prove that the Vanguard is ground out the pace man's jet and to establish that the Vanguard has the lowest operating costs of any aircraft. The time of its drive is set into parts of one hour per passenger mile for a large portion of its long haul use explained. It is planned to be the cost equivalent of the aircraft when changing from its top speed cruising flight. Vickers says that over 100,000 in the cost per mile for the aircraft when cruising

is the 16,000 to 20,000 ft. head-on and cost \$44.

The company also notes to duty are speed advantage required by jet over this distance.

Vickers believes the Vanguard will prove itself based on the fact of the current cheap jet movement in Europe. The presentation points to the fact that in 1966, when BIA introduced its cheap fare on the London Glasgow service. This, Vickers says, is indicative of the greater importance of lower fares over reduced block times in the white business.

Flight tests of Vickers report very favorably on performance to date, with some, much better than had been expected.

The company has two new jets in development flight aircraft in the program. The first aircraft, now pending for installation of maximum equipment, has collected 119 in 12 flights, the second aircraft—the No. 1 DEA machine—77 in 12 flights.

Things are far from without incident. Modifications include a demand for new being listed. The need for a dorsal fin was threatened in some later wind tunnel tests but Vickers hoped to get away without it. Besides the modifications, some early development was required to support the expense rate of the new wind tunnel and a need to boost the effectiveness of the aircraft at critical takeoff speeds due to the low rate of climb in the speed band. An emergency modification has been an attempt to tell power and ventilation of wing generators on the open wing surface.

Capt. Dick Evans, Vickers sales engineering pilot, told American Weybridge that the Vanguard had demonstrated considerable improvement in the pitching plane than the Vanguard and was a "delightful" aircraft to land both by day and night.

Staffing behavior had not been fully investigated but was down to 75 in an aircraft had directed for the aircraft to drop a wing when close to the stall—a feature of the Vanguard. The aircraft also had the advantage of most still suffering from the fact of the Vickers. Evans mentioned that the Vanguard was considerably quieter than the Lockheed Electra and was even quieter than the Vanguard. Gains from the Vanguard would permit low position, and Evans, due to the nature of the two aircraft and the close results of their landing and takeoff speeds.

The aircraft has been getting off the ground in less than 1,300 ft. at its gross weight of 141,000 lb. So far the new engine indicated its speed has been estimated to 270 kt. with 141,000 lb. gross, more tests have been concluded. The first aircraft is currently being equipped



VANGUARD line, for and on in its final assembly at Vickers' Weybridge plant. Third Vanguard's 1,500 ship. Both Koffi Eyo and are being installed on adjacent line.

with the customer equipment and Vickers thinks it will be the first phase of the flight program within 90 days being. Moreover indicated its top speed of 272 kt. will be approached in increments reducing from 20 kt. The aircraft has already been able to demonstrate its maximum cruising time at speed of 625 mph. at 21,000 ft.

Aircraft No. 1 will be instrumented for typical loads and the fourth aircraft will be used for weatherization tests followed by crash proving.

By March and via Vickers hopes to have logged 1,200 hr. with its aircraft in the test program and to be ready for combination with the equipment of some passing.

Recording equipment is based on photographic recording and even in order although some magnetic tape equipment may be used later. In general, one Vickers spokesman said, using one tape recording techniques were too expensive for any single British aircraft company. He mentioned that it was a serious system but there was a tendency to overdo it in the United States which led to considerable loss of flexibility due to the time needed to reduce the data.

Trans Caribbean Fare Approved

Washington—Civil Aeronautics Board last week approved a new fare discount plan for Trans Caribbean Airways which could result in fare cuts ranging from 5 to 20% in the carrier's round-trip fare between New York and San Juan, Puerto Rico.

The Board, by a four to one vote, with Vice Chairman John G. Jones dissenting, denied objections filed by Eastern Air Lines and Pan American World Airways, and allowed Trans Caribbean to offer a 10% discount to passengers departing from either city for a return flight on Monday, Tuesday, Wednesday or Thursday within a one-year period and 10% on the same departing, and if the round-trip flight is accomplished within a 16-day period. The discounts would not apply to first-class fares but would be applicable to lower class fares such as Trans Caribbean's current third class which now runs 345 one way.

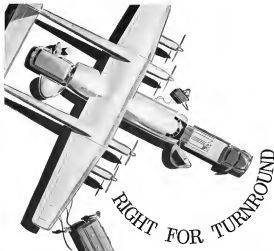
Nothing in the CAB ruling calls for a hearing on the carrier's third and lowest fare question in the Caribbean over the week. Gannett argued that

Trans Caribbean's new discount be in effect in part of the fare, and not in the "lowest fare rule" of any law in the country" without first determining the effect such a move might have on the profits of competing carriers.

Shortly after Trans Caribbean's \$45 fare was approved last year by the Board, Eastern and Pan American were granted increases so that first and second class fares over the same route. When CAB ruled last July, to encourage the low fares in the Caribbean area, member Harold Denney noted that, within less than 30 days after the ruling, the fare on the route increased. Pan American and Eastern, the two current CAB traffic volume than their close fares from \$12.50 one way to \$45 Denney said that, although the carrier had cited a financial need for the fare increase, it later appeared that the higher fare may have been inflated to "inflate" to support the competitive cut in third class service.



ACTION of all three wheels of the Vanguard substructure is mounted (left) in Vickers test rig. A total of 15,000 ft. cycle tests will be automatically programed. Vanguard electrical installation test rig (right) will be run continuously for five years of debugging.



ING FORM-AND-AFT DOORS AT PERFECT LOADING HEIGHT ENABLE THE ARGOSY TO LOAD AND UNLOAD WHOLE CARGOES IN UNDER 90 MINUTES

The new, low handle design changes the transport operation. This is true particularly of air freight where quick turnaround is essential if costs are to be kept to a minimum. With the Argosy's new loading system, the plane developed that will enable the heavy freight hold to be cleared and filled again in a few minutes. With full-width doors at either end of the fuselage, the load can be discharged at one end while new cargo is being loaded at the other. High pressure rubber tires that a turnaround can be completed in under 90 minutes. If the Argosy is used for mixed traffic—a role for which it is particularly suited—passengers and freight loading take place simultaneously.

The use of well-proven components, particularly the Rolls-Royce Dart prop-jets, provides exceptional reliability for round-the-clock operations.

PERFORMANCE

POWERED BY 2 ROLLS-ROYCE DART PROP-JETS
ARGOSY (CRUISE SPEED: 10,000 mph) 90 mph.
MAXIMUM FUEL-BURN: 10,000 lb.
CLIMB RATE: 10,000 ft./min.
MAXIMUM ALTITUDE: 30,000 ft.
MAXIMUM RANGE: 3,000 miles.
MAXIMUM PASSENGER CAPACITY: 100.

THE Argosy BRINGS THE COST OF AIR FREIGHT DOWN TO EARTH

DESIGNED AND BUILT FOR THE FASTER, BIGGER AVIATION DIVISION BY THE T. G. ARMSTRONG NETWORK AIRCRAFT LTD.

SHORTLINES

- ✈ **Aeroflot**, the Soviet state-owned airline, estimates that by 1965 between 70 and 75% of all passengers traveling between large cities will be carried by jet. Private airlines used by the Soviet Union in an unsophisticated form to cater elite transportation and probably will remain so for a long period of time.
- ✈ **American Airlines** has added two Lockheed Electra first-class flights on its Washington-Chicago route. New schedule calls for departures from Washington at noon and 6:15 p.m. in addition to the 5:35 a.m. and 3:15 p.m. flights now in effect. American also has added a Douglas DC-7 flight to Dallas from Washington, departing at 7:45 p.m. and arriving in Dallas at 10:15 p.m. All times are local.

- ✈ **Canadair** 340 turboprop versions of the Canair 440 have completed an 86,000 mi., 16-week flight demonstration circuit in North and South America. The two aircraft gained a total of 5,139 percent an demonstration flights during the period.

- ✈ **Chicago Helicopter Airways** reports that preliminary May traffic figures indicate that it carried between 17,000 and 18,000 passengers during the month.

- ✈ **Continental Airlines**, with inauguration of Boeing 707 Chicago-Los Angeles service scheduled to begin today, says it is spending more \$750,000 for jet training of flight and ground crews. Included in the cost is jet engine training costing \$75,000.

- ✈ **Federal Aviation Agency Administrator Elwood Quesada** is holding jet transport training at the Air Force Boeing KC-115 school at Castle AFB, Calif.

- ✈ **International Air Transport Assn.** reports that Sudan Airways has joined the association as its 59th member airline.

- ✈ **Panagra, American Airlines, Delta, National and Pan American World Airways** have entered into a nonexclusive interchange agreement to provide daily Douglas DC-7 flights from Los Angeles to Dallas, New Orleans and Miami, connecting there with Panagra's 16 jet flights to Panama, Ecuador, Peru, Chile and Argentina.

- ✈ **UAT French Airlines and LIBERIA Union African Car** have signed an agreement which provides for UAT-owned Douglas DC-6B aircraft to operate busy world service over LIBERIA VIA Tripoli Athens Ankara route.

AIRLINE OBSERVER

- ✈ **Watch for an order for three Air Lines of Spain for a fleet of three turboprop transports, probably the Canair 440.** Jose Antonio Sainza, director of the government-owned Instituto Nacional Industriero (I. N. I.), has been in the U. S. with a view of negotiating purchasing turboprop equipment and able for delivery late this year. He also is reported to have completed negotiations for a Reconstructions and Development Fund dollar loan to cover to part the purchase price of three aircraft. I. N. I. will likely the service the balance of assets. There is a letter of intent with Douglas Aircraft Co. last year for DC-3 turboprop transports but apparently now both the Canair is better suited to its requirements on the mid-Atlantic route. The error plan to begin its jet service in early 1966 to meet anticipated competition on its route.

- ✈ **Civil Aeronautics Board** will impose heavier restrictions on dealing with violations of Civil Air Regulations by airline transport pilots than has been necessary in the past. The Board has warned that strict compliance with the regulations is expected because "not only has the number of aircraft increased but the aircraft are faster and larger, enhancing the potential hazards and also the potential magnitude of a single mishap."

- ✈ **Fairchild** and **Whitcomb** JT3C-6 turboprop engines completed over 30,000 hr. of flight during field test months of operation in commercial service. Total of 25 engines have reached the authorized 500 hr. overhaul time. Here's how the JT3C-6 engines compare with the R 2800, which powers the Douglas DC-6, during a comparable period of time. R 2800 engine reached 7,141 hr. operating time per production engine received for overhaul compared with 16,657 hr. for the JT3C-6. Average efficiency for R 2800 was 40 in. per engine per day compared to 7.25 in. for the JT3C.

- ✈ **Leningrad** is becoming a major traffic hub for new Russian turboprop and turboprop flights. Airlines on May 25 inaugurated bi-weekly service between Leningrad and Vladivostok with 75 plane Tu-104s. The 5,000-mile route between USSR's two largest airports is covered in 13-14 hr. with stops at Sverdlovsk, Novosibirsk and Irkutsk. On May 25, direct service between Leningrad and Aden on the Black Sea coast was started with 35-36 turboprop transports.

- ✈ **Trans World Airlines** is experimenting with three extra first-class seats on its Boeing 707 turboprop operation. One place has been being for about a week with that configuration. On the part side of the first-class compartment, second two adjacent configurations has been converted to three adjacent at those locations by converting a table that separates the two rows. TWA says the main idea is to accommodate passengers traveling in groups of three who may prefer this arrangement.

- ✈ **Civil Aeronautics Board** has warned that even by local service airlines to enter the aircraft market will be covered closely. In a statement of potential findings on the new rules of Pacific Air Lines—only local service airline offerings coach flights—the Board cautioned that substitution to Pacific for coach flights should not be construed as "an invitation to the local service industry of large to embark upon similar programs."

- ✈ **Continental** will begin its first engineering and maintenance training program on the 350 turboprop transport in July. First class will be equipped of Trans World Airlines instructors, key personnel and line maintenance personnel. The research course will be divided into specialist groups: line and power plant, structural and systems, electrical and electronics.

- ✈ **Military Air Transport Service** has awarded supplemental contracts totaling more than 55 million for air carriers for overseas passenger airlift during the months of July, August and September. Call commitments of \$692,205 went to Trans World, \$71,913 to Hawaiian Airlines, \$49,878 to Transamerica Airlines, \$219,344 to Alaska Airlines, \$508,100 to United States Overseas Airlines and \$1,186,373 to Transworld Airline. Majority of contracts cover transportation from West Coast military bases to Japan, Guam and Okinawa. Carriers were selected from a total of 25 bidders.

THE OFFICE OF THE AIR... a new standard in executive flying



The Canadair-Conquest "540"
is powered by
Napier-Bell jet-prop engines.

CANADAIR CONQUEST 540

JET-PROP EXECUTIVE VERSION

*Functional for business purposes...
Spacious for prestige executive suites*

The Canadair-Conquest "540" executive aircraft offers a new major development in business flying: the "540" has *airliner size* that provides roomy work-in-flight office space for as many as 24 people, or ample room for custom-designed executive offices, lounges and staterooms... it is jet-prop quiet for normal conversation and work... it is fast, with speeds up to 340 m.p.h., and saves many precious minutes of executive time... it is long-range and capable of one-stop transcontinental flight.

Company officers and corporation pilots will also appreciate these other

important advantages: demonstrably lower cost of operation and maintenance, ability to get in and out of almost any airport, and basic reliability established during the 6,000,000 hours of flying experience of the Conquest series in military, airline, and business use.

Behind the "540" stand the manufacturing reputations of two great aircraft manufacturers, Conquest and Canadair, both members of the General Dynamics family of companies.

This new 'office-of-the-air' merits your closest study.



CANADAIR, Montreal, Canada

Canadair is a subsidiary of General Dynamics Corporation

Your request for a copy
of our brochure will
receive immediate
attention. Contact
R. L. Avery, General
Manager Sales Department,
P.O. Box 600, Montreal.



Centrifuge Checks Orbital Pilot Stresses

By Richard Sweney

Los Angeles—Centrifuge tests indicate that acceleration stresses on a pilot during launch and reentry phases of orbital space flight will permit optimum performance of the pilot in post-flight with suitable controls and displays.

This Avionics Week pilot participated in a typical orbital acceleration profile which was run in a centrifuge at the University of Southern California here.

Pilot's man's performance under acceleration can be degraded according to the degree of fatigue, the orbital acceleration profile was run at the end of a day in which the pilot had experienced two exposures to acceleration, each exposure consisting of about 30 sec. at 3g.

Followed immediately by about the same time period at 4g. In all cases the accelerations were transverse (not to back). The subject also had taken a battery of written examinations so the test was not made under adverse physiological conditions.

The 3g and 4g accelerations were run as part of an investigation being conducted to determine what degradation, if any, there is thinking and performance capabilities as a function of transverse acceleration. Indications are there that no degradation occurs.

There will be physical stresses other than gravity fatigue placed upon a human pilot throughout two spins, either in an orbital capsule such as Mercury or in a vehicle such as DynaSoar, but physicians will be made for reducing

these stresses to the very minimum.

Facilities and equipment used in the centrifuge ran included a plywood frame for a seat, with foam rubber seat, back pads and a headrest. Since the chair or pilot seat was in an very convenient, a rolled-up set of blankets was used as extra support in the rear of the back. No special clothing was worn. A thrust accelerometer was worn during all the runs, both in the investigation and the orbital profile. The seat did not incorporate any sensors or other special provisions which would be a part of a space pilot's seat. No pressure breathing or other rescue equipment was used.

Total elapsed time of accelerations in the launch phase of this typical orbital profile was 430 sec., of which 38 sec. were spent at 3g. The rest period corresponded to the time between burnout of one stage and ignition of another. Reentry acceleration time was 165 sec.

Profile Stages

The profile was in four stages.

• **First stage.** A 350 sec. buildup to a maximum transverse acceleration of 6 g. After burnout, there was a 20 sec. rest period with no acceleration, simulated by stopping the centrifuge.

• **Second stage.** Spent approximately 160 sec., with a buildup to a maximum of 4 g. This in turn was followed by a 10 sec. rest period, simulating the time between second stage burnout and third stage ignition.

• **Third stage.** Buildup to a 110 sec. buildup to a maximum force of slightly over 2g. In the centrifuge, however, a gradual buildup to 2g, a light force, could not be simulated accurately. In actual fact, the centrifuge was started and ran almost the entire time spin at a level of approximately 2.3g over the entire third stage time period.

• **Reentry phase** of the profile, which followed very shortly in the third launch phase, a buildup to 15 to 20 g; afterwards, use a buildup to a maximum force of 8.25 or 8.5 transverse g's for a time span of 160 sec. The actual flight profile would have the peak of maximum acceleration occurring about two thirds of the way through the test spin, at about 110 sec., with an almost uncontrolled curve representing the buildup to maximum, then the coast.

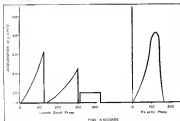
The prime purpose for a pilot to operate adequately under transverse acceleration is experience. This was more



CENTRIFUGE tested stress on a pilot's seat and control system at the left center, this unit is constructed of plywood on a steel mounting. Typical orbital profile lasts 430 sec., of which 38 sec. is spent at 3g to simulate launch.



AVIONICS WEEK pilot Richard Sweney, sitting at orbital acceleration profile is at rest (left), at right, simulating the reentry phase, Sweney is experiencing a transient force of 4.5g. This phase follows simulated separation of the third stage.



ACCELERATION history of Avionics Week pilot, compiled by University of California facilities, shows the 5.5g phase reached in reentry (right) at about 110 sec. Launch time phase accelerations and the time used to reach them are written at left.



PILOT tests are set up on the control box at forward section of centrifuge (left) and right shows problem box at top with battery exposure box at bottom. These lights on the top box indicate acceleration the pilot must make.

lose adequately evidenced to this pilot during the orbital profile.

While taking part in the reentry test prior to the orbital profile, the pilot had been assigned certain tasks to be performed while under the two values of transverse acceleration.

In executing these, a small console which rested on the pilot's knees, was mounted on a wood board, and had

no special hand grips. It combined at two rows of buttons mounted on an aluminum bar about 14 in. high, about 12 in. long and 5 in. wide. During the first two launch stages of the orbital profile, this pilot kept his hands on the console and in the control experiments, although there were no tasks assigned during the profile.

During the first launch stage of the reentry, this pilot kept his hands on

position on the console. Additionally, he was keeping his feet in place on the control board bracket which had been used during the earlier experiments. Here, keeping the arms and legs in place seemed to induce a strain, which was not present or went unnoticed in the earlier runs, quite probably due to the fact that this test, there was no task, or duty for the pilot to perform.

Time period of the buildup to max-



Westinghouse equipment drives

How do you move a 30-ton building at a uniform speed regardless of 80 mile an hour winds that might push with or against it? Westinghouse engineers solved this problem when they designed the automatic shelter drive system for the Dayton/USAF THOR IRBM.

Here is the installation—a fool-proof, self-controlled drive system. The operator pushes the forward or reverse button—the system does the rest, quickly—surely. Westinghouse Reset-D-Versa control automatically compensates for wind pressures to determine the instantaneous power requirement to move the large shelter smoothly and uniformly, regardless of wind direction or force.

This is additional proof of the results you obtain when you use Westinghouse range of products, engineering knowledge, single-source responsibility and ability to supply a packaged, guaranteed unit.

Take advantage of these Westinghouse facilities when designing and building retractable shelters, hardened missile sites, reactors, launching devices or launchers. Contact your local Westinghouse sales engineer or write: Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 988, Pittsburgh 30, Pennsylvania.

An illustration of a hardened missile site, suitable for financing, will be sent you if requested on your letterhead.

THOR retractable shelters

The Westinghouse equipment includes: 75-hp crane and hoist motor; 24 magnetic brake double reduction gear and fly wheel unit; Reset-D-Versa control; pilot generator; manual and automatic switch and controls; and floodlighting.

YOU CAN BE SURE...IF IT'S
Westinghouse

WRITE "WESTINGHOUSE CIRCLE 111" ON READER SERVICE CARD 17-4000-10



Typical THOR installation, showing a sideview view of the drive unit in the retractable shelter, missile, line extending and well of shelter and missile motor.



S-C 2000 BRIGHT DISPLAYS FOR CONSOLE OR LARGE SCREEN PROJECTION

Bright, full-size, flicker-free display of alphanumeric, symbolic and graphic data at high speed . . . simultaneously with PPI-type radar presentations . . . is now provided by S-C 2000 Bright Displays. Displayed data may be viewed in normal ambient light directly on the screen of the S-C 2000 console, or may be projected for group viewing on a large theater-type screen. For air traffic control and military applications, maps may be displayed concurrently with radar targets and their identifying symbols, assisting the operator in geographic orientation. The full-size feature of S-C 2000 Bright Displays results from use of the xerographic process which allows the last frame displayed to be retained permanently, even in event of complete power failure. Send for more complete information concerning S-C 2000 Bright Displays. Ask for Bulletin 6-W. Write today: Stromberg-Carlson — San Diego, 1895 Hancock Street, San Diego 12, California.

GENERAL DYNAMICS
STROMBERG-CARLSON DIVISION



most eliminated the stress associated with this area during test stage. However, an effect appeared during the run which had not been felt before—an effort was required for proper breathing. The figures revealed during the early runs of the day, and the simulated first stage run, good no push for breathing. However, during accidental restarts after an acceleration burn, approximately 7 g's was reached, breathing adequately required the proper technique.

Breathing Procedure

Proper breathing procedure had been to start the run with deep breaths; relax a considerable volume of air within the lungs, continue to breathe steadily and as deeply as possible through the nose. The nose procedure was followed to start the second run, last part 7 g's the effort necessary to inhale properly and continuously increased to an extent although at it no has reached the point where the pilot felt overstrained or in any kind of trouble.

The technique evolved to overcome the problem was to tense the diaphragm and chest muscles as far as possible, and breath as though it was possible with as much force as possible, rather than take the short gasping breaths which would have been a natural tendency.

Following the procedure of deliberately trying to breathe as deeply as possible on a steady inspiration and expiration basis, proved adequate for the acceleration forces encountered throughout the regime.

Accelerations in the recent phase were hard to look, the same phase in the other three stages. This was because the flight simulated a vehicle which would have a re-entrant attitude similar to that of the Project Mercury spacecraft, that is, it would decelerate with the pilot being backward.

Battelle to Study Space Oxygen System

Research leading to the development of a system to free oxygen from carbon dioxide, eliminating a bulky or toxic space flight, has been started by Battelle Memorial Institute scientists at Wright Air Development Center's Vera Michalek Laboratory.

Three possible ways to remove a limited oxygen supply were outlined by Dr. John F. Foster, director of research. They are:

- Use of extreme heat to free oxygen from carbon dioxide.
- Removing basic processes of human metabolism by a chemical reduction.
- Photochemical, "natural" one method.

System design specifications call for a capability of processing carbon dioxide at a rate which will provide oxygen for one or two men from a supply in three years. The system also must operate efficiently at an atmosphere one-third as dense as the earth's, at sea level.

In addition, the proposed system must be independent of the flow of gases, must operate on a minimum of electrical power or heat energy and must be as light and compact as possible to operate with a minimum of maintenance.

At present, Dr. Foster said, the nature of chemical reduction "means, it

has been to treat much more than once requirements." He said the system involves a reducing agent to convert carbon dioxide into solid carbon, as a fuel gas, the oxygen would be recovered as a gas.

The scientist added that photochemical processes in which green plants manufacture their food supply and give off oxygen—photosynthesis and a "rigid structure." Last pointed, according to Dr. Foster, is the method of being active in use of extreme heat or thermal decomposition. He cited poor efficiency and extreme weight of necessary equipment.



Illustration For The Book Of Knowledge

Before this failed piston hits the scrap heap, an Airwork inspector makes a highly detailed photo of it. This photo becomes part of our study file of possible piston malfunctions . . . of scuffing and burning.

For example, a piston shows wear in an unusual area. Not enough to require replacement at this overhaul—but . . . what caused it?

Airwork photographs the condition . . . pulls out the photograph for accurate comparison the next time the piston goes through overhaul. We know if

the original wear condition is potentially dangerous—or whether it is safe for another run.

This is one more example of how Airwork uses modern methods—backed by craftsmanship—to make sure every part returned to an engine will give satisfactory service throughout the entire operating cycle up to come.

You are safer with an Airwork overhauled engine — because Airwork takes more time and trouble to be sure your engine is in first class condition.

Airwork
CORPORATION
Millville, New Jersey

BRANCHED IN:
WASHINGTON
NEWARK • MIAMI • ATLANTA
CLEVELAND • NEW YORK



1.2
(COST PER SEAT MILE*)

THE NAPIER JET-PROP CANADAIR-CONVAIR 540

Napier 3000 hp. jet-prop engine will convert your Convair 340/440 into a jet-prop Canadair-Convaire 540 . . . or you can buy a brand-new Napier-powered Canadair-Convaire 540.

- Terminal to terminal operation on routes up to 600 miles—multiple stops—without refueling—with full passenger load and normal reserves
- 326 mph. guaranteed cruising speed at 28,000 feet
- Comfortable seating properly adjusted to your requirements—up to 56 seats
- Increased passenger appeal—because noise and vibration are minimized
- 96% reduction in climbing time to cruise altitude
- 20 years of profitable service life ahead

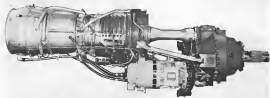
A world wide demonstration flight test is now under way. Arrange for your own flight by writing to Napier Engines Inc., 909 Dupont Circle Building, Washington 6, D. C.

*56 seat configuration 520-mile stage



A SUBSIDIARY OF G. NAPIER & SONS LTD., LONDON, ENGLAND
A MEMBER OF THE ENGLISH ELECTRIC GROUP OF COMPANIES

AERONAUTICAL ENGINEERING



TURBOPROP version of General Electric T64 engine produces 2,570 equivalent shaft horsepower and weighs 1,279 lb.

T64 Designed in Three Basic Versions

By Cecil Bevan

Washington—General Electric is offering its lightweight T64 turbine engine in three basic versions—turbojet, turbofan and direct drive—as is planned for present and future aircraft and as the powerplant for its aircraft and helicopter now on the drawing board.

Developed by GE's Small Aircraft Engine Department, Lewis Mass., under a \$10 million Navy contract that will cover it through its 150-hr. qualifi-

cation tests, the T64 was designed specifically for high-performance transport and military aircraft. Primary goal during its design was low specific fuel consumption, with weight a secondary factor.

Turbojet Version

The 2,570-shp turbojet version weighs 574 lb and has an sfc of 0.586; the turbofan weighs 1,279 lb, delivers 2,570 shp and has an equivalent specific fuel consumption of 0.532. Shaft speed is 5,200 rpm for the T64-2 turbojet, 1,150 rpm for the -4

turbofan. Overall length of the -2 is 91 in., of the -4, 113 in.

The demonstrative version of the engine, obtained by removal of the gas box, weighs 710 lb, has an sfc of 0.696 and a specific fuel consumption of 498 according to General Electric. Shaft speed is 11,600 rpm.

The jet engines now running on the test stand at Lewis have accumulated a total of slightly more than 500 hr. The -4 turbofan, first tested in January, is scheduled to complete its 150-hr. qualification test by December, 1961. The -2 turbojet made



T64 TURBOFAN version has essentially the same internal components as the T64 turbojet, basic wide-throat gas is common to both engines.

AVIATION WEEK, June 5, 1959

AERIAL REFUELING TANKERS **STRATEGIC** **OR** **TACTICAL**

Now, in a matter of minutes, Air Force tankers can be converted from a strategic to a tactical role.

This kit is designed for field conversions from the boom system to the probe and drogue system—successfully tested and now operational with the Air Force.

The kit containing all components, spares and test equipment is designed for storage aboard the tanker aircraft. Thus equipped, Air Force tankers can refuel most aircraft anywhere in the world.

SCHULZ TOOL AND MANUFACTURING CO. is proud to be associated with the design, test and manufacture of this advanced aerial refueling equipment.



SCHULZ TOOL AND MANUFACTURING CO. has, for many years, worked closely with the various services and the aircraft industry in the design, test and manufacture of equipment related to modern aircraft fuel systems. This experience is available to assist you from design to efficient manufacturing.



SCHULZ
TOOL & MANUFACTURING CO.



PUMP PRIMERS

by
Arthur A. Nichols

"Generator Pumps Better Than Spur Gear Pumps?"
Yes, in many aircraft applications, generator pumps are far superior to conventional spur gear pumps. This is a completely unqualified opinion because we are a leading manufacturer of both types and are committed to neither. In fact, the first pumps we made, built in 1945, were spur gear pumps. These accurate, motivated pumps are produced from the copper, steel, aluminum, nickel and other expensive three metal alloy steel.

For such accurate applications as fuel, oil, hydraulic and hydraulic systems, pumps are the different, important, and most difficult to maintain. These are the very small, black, which generator pumps are specifically designed to meet.

The efficiency of generator pumps for aircraft applications is proven from their simple design — only two moving parts rotating in the same direction around a single shaft — and their extraordinary adaptability to difficult and space restricted conditions. (Fig. 1)

The generator pump single shaft, with its single main rotation, is only half the rotational bearing, wearing and maintaining a spur gear pump's bearings. Such wear is generator pumps is far less than in spur gear pumps having the same shaft speed. That's because their elements are solving in the same direction have been designed to spin. For example, in a pump with a 1000 rpm generator, at only 360 rpm in rotation to each other.

Operation adaptability is inherent in the generator pump. By varying direction, clockwise and back and forth, the generator elements, a needed capacity can be built into a wide variety of engine directions. Multiple functions, such as fuel, oil, hydraulic, etc., can also be obtained by stacking generator elements along a single shaft. (Fig. 2)



Fig. 1 Multiple generator pump. Turned down, engineering assistance and production facilities are available. Write today to receive.

W. H. NICHOLS CO.
Wood Ave., Waltham 54, Mass.



COMPARISON of fuel costs and single between a piston engine and the 7662 turbine engine is outlined in General Electric chart (left). Fuel-cost savings comparison is at right.



is first run in March and has a target date of August, 1960, for completion of its 104th qualification. Expected flight tests are expected to begin sometime next year.

The development program is laid out by project manager Edward Wall calls for a total of approximately 10,000 hr to have been accumulated by the time qualification testing is completed.

General Electric first made its proposal for a 104-type engine with low specific fuel consumption to Nav's Bureau of Aeronautics approximately five years ago and now Wall says, "In the face of the general philosophy that you don't look at an engine if you don't have a specific aircraft to go into it." Actual work on the engine was begun in 1957.

At present, such advance definitely scheduled to take the T64 to the new-powered version of the Sikorski S-60B long range (AW, April 28, p. 29). Sikorski plans to use the T64 in its 104-type engine for the present 1,100 hp Pratt & Whitney T5800 piston engine should boost the S-60B's payload by as much as two and one-half tons and probably provide added range.

Projected Uses
Projects being considered by Bureau of Aeronautics for the engine include an STOL version of the Grumman S-2F carrier-based antisubmarine warfare search plane and an attempt to fit into Nav's "box plane" concept as a platform for its long-range light jet to jet defense needs.

A number of engine companies including Boeing, Chance Vought, Convair, Fairchild, Grumman, Martin and Vertol also are developing the various variants of the T64 with General Electric. These include, according to Wall, use in cargo-lift helicopters, medium (with two T64s) and water-borne dual use in light aircraft and submersible surface craft VTOL, and STOL, transport and offshore early warning planes.

As a possible prototype for VTOL, following applications, the T64 was designed with a built-in capability of operating horizontally at an attitude 90 deg above the horizontal. It also can be operated 45 deg below the horizontal for use in helicopters performing air-to-ground and air-to-water landing missions.

In addition to its incorporation into new designs, project manager Wall believes that the low specific fuel consumption, the relatively low cost in turboshaft fuel and the light weight of the engine may make it economically feasible for the Navy or other services to acquire present present capabilities with the T64 on a number of existing aircraft.



CHART shows engine output specific fuel consumption rate comparison piston engine.



NEW tungsten linings for rocket nozzles...

MELTING POINT: 6170°F.

Tungsten-lined lightweight nozzle for solid propellant engines are now being fabricated by General Electric. With a melting point of 6170°F, tungsten is among the highest temperature lightweight solid and flexible nozzle in use in the missile industry, enduring high rocket propellant temperatures and pressures with no measurable erosion.

These nozzles are produced by an arc-spraying process patented by General Electric. Tungsten is evaporated in an arc and deposited on a substrate. For some applications, the liner is sintered in lightweight plastic, and the nozzle is baked out.

Arc-sprayed nozzles have been hot-fired with the new high temperature propellants at several locations.

G.E.'s capabilities in metallurgy and manufacturing are combined with equally advanced capabilities in engineering, research and development. Integrated advanced rocket engine capabilities at General Electric can meet your needs for high performance solid propellant engine cases, nozzle and liquid engine components using cryogenic and storable propellants.

Progress Is Our Most Important Product

GENERAL ELECTRIC

The Right Propellant Is Key

Every Department's Rocket Engine Division is the nucleus of General Electric's solid propellant engine and test facilities. It is well equipped, and it uses Company-wide capabilities and experience to speed answers if you would like more information about the material's products and its capabilities in solid or liquid propellant engines, please write this company.

Request Section, General Electric Co., Cincinnati 21, Ohio

Section 210-2
Rocket Engine Section
Flight Propulsion Laboratory Department

General Electric Company
Cincinnati 15, Ohio

Please send me additional information about General Electric solid propellant cases and nozzles (210-2102).

I would like to receive G.E. rocket engine products with a sales representative.

Name _____
Title _____
Company _____
Address _____
City _____ State _____



1 2 3 generations of airborne digital computers (from first generation to third)

In the photo above, the three ARMA computers have been intentionally distorted. But the cut-outs accurately represent the relative size of the three generations of ARMA airborne digital computers.

The larger size has been in production since 1957. The middle-sized one (a quarter the size of today's) will be in production in 1960. And the micro-miniaturized version in the engineer's hand will be operational in 1962—only .3 cubic feet in volume.

A production line unit of ARMA's current model has operated in excess of 4000 hours without a component replacement. And the 1960 and 1962 versions will have reliability factors at least equal to this.

With this program of miniaturization, ARMA has made the digital computer truly airborne. ARMA . . . Garden City, New York. A division of American Bosch Airma Corporation.

1119

AMERICAN BOSCH ARMA CORPORATION



T2J Jet Trainer Completes Carrier Tests

North American T2J jet trainer landing hook cleared for a "bushy edge" carrier landing, makes final approach over the stern over the USS *Arcton* test of Navy's control deck system. Carrier suitability tests were made by three T2Js and were completed successfully after about 50 completed takeoffs and controlled landings, plus another 50 hours of pilot flight time—between Potomac River, Md., a nearby airport.

without risk of damage. The effect of the engine and fuel air stages are variable. The intake, a steel unit split and flanged along the horizontal centerline, has removable intake cones.

• **Compressor** has a stage-to-stage full variable flow split for assembly and replacement. A single fuel manifold feeds 12 duplex-type fuel nozzles with integral flow dividers. The nozzles are mounted on the compressor rear frame over diffuser walls.

• **Gas generator turbine** is a two-stage, dual-flow type coupled directly to the compressor rotor by a spline connection. A low-pressure air engagement starter assembly is located on the turbine casing. Pressure also has been made for mechanical starting.

• **Power turbine** is mechanically independent of the gas generator turbine.

T84 Maintenance

Another feature which Will and General Electric hope will boost the T84's chance for a long and profitable life is the maintenance built into the engine during its design. Maintenance features include:

• **Main induction piping** is replaceable in a unit from the basic engine bay servicing and inspection.

• **All blades, vane, compressor and turbine** can be inspected, removed and replaced individually without disassembly of the engine except for the removal

of the damaged compressor or turbine casing.

• **Compressor case** can be taken apart for accessibility and to permit inspection and replacement without complete disassembly of the engine.

• **Nozzles and ignitors** are replaceable without engine disassembly.

• **Scrub, third and fourth stage** diagnostic can be inspected and replaced without complete disassembly of the engine.

• **All fuel lines** are located at the bottom of the engine.

• **All accessories** have been placed in one area to facilitate servicing.

Weather Sensor Tested in T07

Airborne weather sensing system developed by Radio Airborne Corp. has completed initial flight testing aboard a Boeing T07 jet transport operating out of Yafus, Wash.

The system gives forecasts a three-dimensional view of a "weather picture" transmitted from the aircraft (AWT Oct. 6, 1958, p. 50).

Radarwaves are emitted at high velocities at intervals of several hundred miles. Radar engines and ground test firing of the radarwaves will be conducted soon at Holloman AFB, N. M.

QUICK CHECK



LISLE Magnetic CHIP DETECTORS

A powerful Alnico magnet in the Lisle Chip Detector attracts any ferrous metal particles present in the lubricant. These particles bridge an electrically insulated gap and complete an electrical circuit for a positive reading on a continuity tester.

This quick, positive check provides an advance warning of possible internal breakdowns before engine failure.

A continuous in-flight warning system can be provided by wiring the Chip Detector to the pilot's or flight engineer's panel.

Write for Free Catalog and Samples. No cost.

LISLE CORPORATION
Cincinnati, Ohio



Avco Research and Advanced Development Division and Dynatronics mobile system to measure weight and center of gravity of experimental X-15 nose cone.

PUTTING THE BUSINESS END... IN BUSINESS

The nose cone or "business end" of an X-15 will disintegrate from the violent shock and 15,000°F temperature that builds up as it plunges back into the dense air surrounding the earth's surface, unless recovery can be made at the optimum attitude.

Dynatronics has developed a Weight and Center of Gravity Locator for precise determination of weight of the nose cone and CG components along its 3 principal axes as part of the procedure for insuring that the nose cone will be aligned properly as it re-enters the atmosphere. Avco Research and Advanced Development Division, developer of re-entry vehicles for the Air Force Titan and Minuteman ICBMs, are successfully using a Dynatronics Locator to put the "business end" in business.

The Dynatronics Weight and Center of Gravity Locator combines the accuracy of a laboratory static balance indicator with the ruggedness required for field usage. At the flip of a switch, this unique instrument gives easily legible digital readout of weight and

center of gravity for two axes of the nose cone. Then, by rotating the nose 90°, another reading is obtained in the same manner along the third axis. Measurements are independent of gravity variations since the instrument operates on the principle of gravity induced balance rather than spring deflection.

Capacity of the Locator is more than 4,000 lbs with an indicator resolution of tenths of pounds. The Locator is mobile, is air transportable and is adaptable to quick field setup. This instrument can be used by untrained personnel — a most significant feature with reference to the operational phase of missile work.

The Weight and Center of Gravity Locator is a typical example of Dynatronics' capabilities in solving difficult field and process measurement problems. With its individual information plus any one of the Dynatronics three axes of Locator, Aircraft Engines and Equipment such as Thrust Test Cells, CG Locators, Arm Strong Balances and Kinetic and Aerobic Motors, Drilling, Pressurizing, and Drilling Systems, Pressure Measuring Instruments such as Manometers, Primary Pressure Standards, Digital Transmitters, etc.



DYNATRONICS CORPORATION
 16000 Industrial Park • Dept. 16 • Redding, Conn.

Centrifuge Furthers X-15 Pilot Safety

Los Angeles—Details on G-suits crafted during this centrifuge program run on the North American X-15 rocket research vehicle, including its parts of acceleration and constant forces, were presented here recently.

Centrifuge programs were run at Avco's Medical Development Laboratory, Naval Air Development Center, Johnsville, Pa. Instrumentation package was developed at North American Systems, designer of the X-15. Both presentations were made during the Aerospace Week meeting here.

Information on a physiological extra-suitcase package, which was designed for the X-15 program, also was given.

Response Patterns

During the experiment for collecting data on the response pattern of pilots undergoing tension and stresses in similar to those which would be encountered in space flight, the Aero Medical Laboratory at Wright Air Development Center conducted development of a package with this capability in 1958, which could be used in the X-15 research aircraft, according to W. V. Blocker, of North American Aviation, Inc.

The system provides for recording aboard the airplane by means of conventional photographic technology, and channels of physiological information, plus two channels of pressure reference from selected to positive, functioning

of the full-pressure suit. These two channels are introduced to be introduced to the ground by the aircraft's base telemetry system.

The package includes a low differential electrocardiograph amplifier, from this output bridge circuit for temperature measurement bridge circuit with a pressure compensation for a heated thermistor type pneumotachometer and two pressure transducer bridges. Power supply is included. The colored report sheet also has leads for the pilot with a novel design of light weight electrocardiogram electrode, a new means of electrode attachment, three disk type skin thermometer pickups and a scaled steel thermometer gauge.

Also, included are two miniature strain gage transducers with housing for installation in the pressure suit, a para-mechanical flow meter for metabolic flow in the oxygen breathing system, and electronic circuitry connecting with the aircraft system as well as provisions for manual attachment artificial respiration for flight element of the system without a human pilot, and connector ports with snap fastener components for conducting the full pressure suit to the amplifier.

The low electrocardiograph differential amplifier, motion transducer and pressure transducer and performance characteristics comply with the require-

ments of VA Specification 3343271A for direct reading electrocardiograph. Flight space has been left in the design and program plans and leaving an extremely sensitive and rugged. This was done in the interest of reliability, freedom from and ease of maintenance, and using the relatively broad space allowed in the X-15 bus for installation of the package.

Further instrumentation will be used when extensive flight service has been flown the aircraft.

Electrode Design

Electrode design was such as to assist the constant requirements under the tight fitting full pressure suit for long periods. One of flexible Munsell metal mesh has a thin lead inserted to it with insulated pressure sensitive to the air flow strain gage. The leads are connected to the suit at a suitable connector pad.

Electrode placement on the pilot represents a compromise between the desire for the classical lead leads and the requirement to minimize muscle potential noise. Compromise was worked out to minimize noise pickup in the system, set circuit is close as possible to the conventional electrocardiograph site.

Three skin temperature pickups are used with bridge circuits designed to accommodate a temperature range from 50 to 120°F. Resistor metal probe



"Q" BALL, records attitude errors for the North American X-15 research vehicle, has completed National Aeronautics and Space Administration specifications at Edwards AFB, Calif. (AW Dept. 15, p. 95). Temperature and pressure reported during the recovery phase of flight was produced by mounting the "Q" ball on a steel framework in the exhaust wake of an F-100 jet fighter. Aircraft was with rest of NASA's third collection used to that engine could be operated as full altitudes. Two new test of 5 and then a 7 and was conducted with the "Q" ball at 24,000 ft. In the horizontal, controlled to be the maximum recovery attitude during re-entry. Developed by Northrop Division of Northrop Corp., "Q" ball made at Avco's X-15, which is a recovery in light integrals. The device will be mounted on the nose of the X-15. Velocity of the exhaust wake was approximately Mach 1.1, true temperature was 3,700°F. Nostrous response was that "Q" ball without data frequencies of about 2,000 Hz and pressure of 2,000 psi.

Moment of Decision

(Continued from Inside Book Cover)

The observer was standing up with his arms folded and his empty machine gun laid down over the edge of the cockpit. Could the American shoot down an unarmed enemy? He hesitated. There is a moment of decision, he remembered again and started flying. In that moment, Lt. Douglas Campbell became an American ace of World War I. The German Rumpier was his fifth officially confirmed air victory.

At 22, Doug Campbell of San Jose, Calif. was flying in 94 Squadron—the famed "Hat-in-the-Ring" squadron that was destined to score a record of 69 enemy kills. A graduate of Horsham

and Harvard, Campbell was sent to Paris as a cadet in August, 1917.

Since there were no trainers available for beginners, Campbell entered an advanced flying class. He learned to fly in a dark scout—a Nieuport 23. From the model 23 Campbell progressed to the Nieuport 28.

Campbell and his fellow Americans found the 28 simple to fly. Although it suffered strong gyroscopic effects from the rotary engine, the 28's maneuverability and rate of roll were outstanding. The plane tended to spin easily, but recovery was quick. There was only one valid complaint against the 28: its susceptibility to fire, caused by accumulation of gas in the cooling system had been cut off from non-firing cylinders, and its wing fabric shedding

in high speed dives. But properly handled, the 28 was a safe and superb fighter.

On April 14, 1918, 94 Squadron received the first war flight order given to a squadron completely manned by American pilots. It marked the maiden flight over enemy lines for Eddie Bickelshausen. But credit for shooting down the first German plane that day—the first such kill by a member of the A.E.F.—went to Doug Campbell. In the past few weeks he scored three more victories.

Then on May 11, Campbell went out alone looking for trouble. His destruction made him an ace. Five days later he had scored another Rumpier, his sixth and last victory. In the last

seconds of his air battle, an explosive bullet fired by the German observer exploded within Doug Campbell's back.

Doug Campbell never fought again. He remained to die in November, 1918, only to find that the fighting days of his last squadron were over.

Heritage of the Air

One of the most inspiring chapters in the history of flight is the story of the men and flying machines of World War I. It is a highly personated story of brave men and the steel, wire and iron that can create manpower to conquer. Because it shows the many fine traditions of aviation, Leach is proud to present this Heritage of the Air Series.



94 SQUADRON—since 1908, more the more than any other American squadron.

EXACTLY WHAT IS A "SUB"?

We doubt that anyone has yet accurately described the role of the sub-system contractor. We therefore submit the following. The sub-system contractor:

- Directly supports the system manager and the system prime contractor;
- Supplies subordinate systems that contribute to the overall utility and reliability of the entire system project;
- Offers broad capabilities and depth of experience in electronic and electromechanical research, design, engineering and manufacturing;
- Contributes consistently to such important research and weapons system programs as Atlas, Thor, Jupiter, Bomarc, Titan, Polaris, F-364, F-380 and others; and
- Demonstrates capabilities in management, finance and operations that are based on a full understanding of the requirements for the productivity and reliability of the entire system project.

We hope system managers and prime contractors accept this definition as the basis for selecting "subs."

We'd welcome the extra business.

For electronic sub-systems and electro-mechanical components to meet the requirements of the space age...

ELECTRONIC SUB-SYSTEMS Instrumentation Sub-Systems • Inverters and Converters • Ground Support Equipment • Power Conversion Equipment • Control and Distribution Equipment • Automatic Production, Inspection and Test Equipment

ELECTRO-MECHANICAL COMPONENTS Relays • Connectors • Switch Swirling Devices • Tape Drums • Multichannel Switches • Microchannel Controls • Timers • Programmers • Tape Readers • Accessory Equipment • MECHANICAL Accessories

FROM THE HELMET-AND-GOGGLES ERA to the space age, Leach has served the industry of flight with components of unsurpassed reliability...with power conversion and instrumentation sub-systems...and with unique technical capabilities.

Solving problems is the core of the Leach philosophy of doing business. For more than a quarter of a century, Leach has steadily built a tradition of anticipating customer needs—and meeting them with advancements based on specific requirements.

This is why Leach components and sub-systems can be found in the vast majority of today's operational aircraft and in most major missile projects. This is why Leach is uniquely equipped to meet the varied challenges imposed by the new and constantly evolving concepts of today's weapons and communications systems.



LEACH CORPORATION

10435 SUSANA ROAD, COMPTON, CALIFORNIA

DISTRICT OFFICES AND FIELD REPRESENTATIVES IN PRINCIPAL CITIES OF U.S. AND CANADA. EXPORT: LEACH CORPORATION, INTERNATIONAL DIVISION

Ground support sub-systems, such as this low-voltage power supply unit, utilized under the wing of a DC-4, are custom designed, engineered, and manufactured by Leach's fast division.



NEW LOW-NULL MOTOR GENERATORS

HOLD DOWN OUTPUT NULL TO 0.003 AND 0.006 V.

Daystrom Transcoil has whittled the null output voltages of its 8me 9 and 11 Motor Generators down to a mere 0.001 and 0.006 respectively. Signal to noise ratio gets a big boost up to 18:1 for 8me 9 and 100:1 for 8me 11. Linearity is within .35%. A wide range of gear ratios can be furnished.

Complete specifications with drawings and charts are yours for the asking. Other types and sizes of motor and motor generators are also available. And be sure to get complete details on our new synchro

line. Daystrom Transcoil, Division of Daystrom, Inc., Waukegan, Montgomery County, Pa. Phone: JUND 4-2451. In Canada: Daystrom, Ltd., 840 Catherine St., Toronto 19, Ont. Foreign: Daystrom International Div., 100 Empire St., Newark 18, N.J.



DAYSTROM TRANSISCOIL DIVISION OF DAYSTROM, INC.

Representatives in Canada and Other Foreign Countries

for an individual calibration for the frequency range 64 to 1057. The indicated ranges can be altered by means of a balance adjustment in the circuit.

The pneumotachometer located in the oxygen supply line to the helmet has one heated thermistor and two schottky air compensating thermistors in a bridge circuit. Degree of bridge unbalance is recorded and is directly proportional to the rate of heat loss from the nose thermistor to the oxygen stream. This heat loss is in turn proportional to the square root of mass flow rate. Producing a logarithmic record, data must be converted to linear coordinates to reproduce the linear shape of human respiratory flow cycle. Calibration has confirmed that the response of the device is entirely adequate for reproduction in a record.

Two miniature strain-grip piezoelectric transducers are used in the suit to monitor suit and helmet pressures. One is mounted on the gas collection layer of the suit, with one side exposed to ambient pressure and the other to suit pressure. The second is mounted in a pocket inside the suit with a occlusion line it connected by a rubber tube to a syringe which protrudes the end, and of the suit. Thus, the latter indicates the differential existing between the helmet and suit. For safety of the wearer, the helmet pressure is shown slightly higher than that in the suit to ensure that only pure oxygen is breathed.

Environmental Tests

Environmental tests of the complete package have included operation under the following conditions:

- Temperature: from -20 to +100°F
- Altitude: up to 15,000 ft
- Vibration: up to 10g at frequencies from 10 to 500 cps
- Continuous replication of the first flight demonstration of the system was accomplished on a Convair TF-42L, operated by the Hansen Factory Branch of the Air Force Flight Test Center, Edwards AFB, Calif. Work was to duplicate flight with characteristics of the X-15-1 flight program.

It is contemplated that additional parameters may be assessed by the package in future versions. Those in need for early studies are:

- Automatic blood pressure recording
- Photoelectric plethysmograph
- Polarographic chemical sensing oxygen partial pressure in respiratory gases
- Sample rate-transducer recorder of transient skin responses. This would detectable skin changes or neural changes in skin resistance, and would respond only to transient, cyclic physiological responses generated by discrete stimuli.

Some findings resulting from con-

TWO-LAYERED LIQUID

P-1075

REMOVES CARBON & PAINT FAST!

P-1075* CLEANS QUICK! Rapidly removes carbon deposits, grease, and oil from jet and piston engine parts—strips most paint—excellent for removing zinc chromate primer from steel-aluminum.

P-1075 CLEANS SAFELY! Non-flammable, and non-corrosive to steel, aluminum, zinc, cadmium, magnesium, copper and lead.

P-1075 SAVES MONEY! Economical to use— seldom requires stripping lines that for either large or small shops and for heavy production jobs like engine overhaul.

P-1075 RINSES FREELY! Easily rinsed with hot water or petroleum solvents. Leaves parts bright and clean, ready for inspection or return to service.

P-1075 NEEDS NO HEAT! Use at room temperature— requires no stress or heating. Excellent for use at outlying points or in shops where extra heat is not available.

For more details on P-1075—or information on Wyandotte's other aircraft-cleaning products—call your Wyandotte representative. Or mail the coupon below. *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Also Los Angeles, California, and Atlanta, Georgia. Offices in principal cities.*



Wyandotte CHEMICALS A S. FORD DIVISION

Specialists in Aircraft Cleaning Products

MAIL COUPON TODAY!

Wyandotte Chemicals Corporation, Dept. 2123, Wyandotte, Mich.

Name and address are:

- | | |
|--------------------------------------------|-----------------------------------------------------------------------|
| <input type="checkbox"/> Paint Stripping | <input type="checkbox"/> Aluminizing and Brightening |
| <input type="checkbox"/> Aircraft Cleaning | <input type="checkbox"/> Stripping, Etching, Pickling |
| <input type="checkbox"/> Electroplating | <input type="checkbox"/> Chemical Treatments for Surface Modification |
| <input type="checkbox"/> Corrosion Control | <input type="checkbox"/> Surface Polishing |
| <input type="checkbox"/> Metal Cleaning | <input type="checkbox"/> Chemical Milling Aluminum and Magnesium |

NAME _____

POB _____

ADDRESS _____

CITY _____ STATE _____

WHITTAKER SPHERICAL PLUG VALVES



RELIABILITY—PLUS UNLIMITED SCOPE FOR FLUID-FLOW CONTROL

These compact valves afford split-second control in high pressure and cryogenic flow systems. Whittaker's spherical plug construction provides the efficiency of "straight-through flow" with negligible pressure drop—almost constant low operating torque regardless of pressure ... for unlimited advantages of flow control! Available in a wide range of sizes, each valve is designed to customer specifications—may be actuated manually, pneumatically, hydraulically, or electrically. Since 1965, Whittaker Spherical Plug Valves have been produced in quantity for both missile and aircraft applications—let Whittaker engineers help you with your design problem. Write, wire, or phone.

Three-given Reliability
In Hydraulic-Pneumatic Flow Control



WHITTAKER CONTROLS
DIVISION OF TELECOMPUTING
CORPORATION

BRANCH OFFICES: New York, Dayton, Seattle, Wichita, Atlanta

110 N. Glass Ave., Los Angeles 38, Calif. • DD 4-6141



First Vertol YHC-1A Helicopters Near Completion

Four three-Vertol YHC-1A four-engine helicopters for the U. S. Army were completed at Vertol's Marine, Tex., plant. Powerplants are two Learmonth T55 turboshaft engines; areas later aircraft will have General Electric T55-6s. Aircraft is the scaling version of the Vertol B07 (AV 15, p. 42) now being demonstrated in U. S. and European government and military officials. First YHC-1A will enter its initial flight this month. Army will order an additional number to replace its inventory of piston-engined helicopters.

Flight simulation of the X-15 seventh aircraft was outlined by Carl Clark, Aviation Medical Acceleration Laboratory, U. S. Naval Air Development Center, and C. H. Wooding, National Aeronautics and Space Administration, Langley Research Center.

Flight controls for the X-15 sought a balance between having larger stabilizing surfaces and their consequent decrease in performance, and adding electronic stability. The compromise was made in such a way, according to Clark and Wooding, that even with electrical failure of the danger vortex, a well-timed pilot's reflexes and a secondary control under these conditions.

- If he could locate the acceleration and the acceleration.
- If he had selected prevented him from being launched about.
- If he could still read and interpret his instruments while under the stress.
- If he could still maintain control of the point of flight path without making uncalculated pilot inputs to further evade such conditions.

No Previous Studies

No previous studies have been made of human behavior in simulating, and custom of the magnitude and duration expected in this space of the X-15.

North American outlined the following conditions in the X-15 program by separating their methods of instrument and external and subsequent, of instruments, controls and control techniques at will.

In the speed of Mach 2.5, to July, 1958, three X-15 programs were carried out as a cooperative effort of North American, U. S. Navy, National Aeronautics and Space Administration and Air Force.

Since the helicopter controls had only 1 deg. of freedom of motion, rather than 5 deg., emphasis for these studies was on simulation of the three-axis acceleration components.

An important reason provided control of the controls; proportion to the pilot inputs, data from the analog computer also serves to drive the pilot's manual display, giving him the proper feeling for the control inputs.

In the second and third X-15 programs at the controls, a total of 951 "static" flights in which the controls were at 100 and 150 "dynamic" flights in which the controls were in motion, were made in seven potential X-15 pilots and 22 others.

The second program showed the potential of being able to "fly the aircraft below it a half" with the pilot receiving the expected flight loads for carrying out the mission under his own control. The second program showed the great sensitivity of pilot control required to make a successful climb, following certain danger factors, as a third program was carried out with repeated cockpit and computer simulation.

For the second and third programs, the controls had a number of provisions to prevent accidental damage to the pilot, either through ground or air

control steps which provided the controls moving to a position which would generate dangerous negative loads to the pilot, or loads detrimental to the controls itself. Additionally, several observers including a medical officer, were always on hand to watch both the pilot's reaction through motion instrumentation and through computer data in the controls itself.

From the controls simulation studies, according to Clark and Wooding, it was determined that pilots wearing adequately functioning anti-g suits or the suit-belt provisions of the various paratrooper full pressure suits can tolerate the accelerations expected for the X-15 as long as they maintain control of the control.

Pilot Gray-Out

Gray-out was experienced by two subjects in the first of the test simulation, while being brought up to 2 minutes of full vision was required within a few seconds, presumably by acceleration compensation.

Situations of hanging and pain can occur with accelerations either being blood into or out of dependent portions of the body. At the end of the test phase, due to the test of the X-15 being typical loads 12 deg., there is a physiological negative (or vertical) hanging blood and fluid into the head. Forings were reported of fluids going in the throat through connections, and of some difficulty in swallowing, but these were not particularly disturbing. Respiration and concentration could be carried on as in the X-15 the legs are extended.

TOUGH Connector Problems SOLVED!

- ✓ SELF-ALIGNING
- ✓ 1000 CONNECTIONS
- ✓ PRODUCEABLE in large or small quantities
- ✓ LOW PRESSURES for insertion and extraction
- ✓ REMOVABLE ... 0% to 100%
- ✓ ATMOSPHERE ... air, water, salt water, jet fuel, solvent gases, oil, hydraulic fluid
- ✓ PRESSURE ... 0 to 70 psi
- ✓ OPERABLE by mechanical master/slave
- ✓ TEMPERATURE ... -65°F to 180°F
- ✓ VIBRATION ... 100 Gs (See Wyle Report below)
- ✓ POSITIVE LOCK-UP and tip-lose disconnect
- ✓ VARIATION LEVEL ... 1,000,000 changes per hr.
- ✓ EXPLOSION PROOF
- ✓ DEAD FRONT
- ✓ SEQUENCE SWITCHING
- ✓ LIGHT WEIGHT
- ✓ HERMETICALLY SEALED
- ✓ TROUBLE FREE
- ✓ LOW TYPING COST
- ✓ HIGH VOLTAGE
- Under development

Many tough electrical connector problems have been solved by Cole Electric Co. in recent months. Because of the ability of revolutionary new Cole self-aligning, ball-and-socket connector pins to operate under extreme conditions, all of these problems have now been solved. Special Cole Connectors have been developed to meet up to 2000 contacts have been developed to meet difficult environmental and operational requirements. For aircraft, missiles, ground support, computers, medical, electronics and electrical equipment.

Whatever your connector problem might be, a special Cole Self-Aligning Connector may provide the practical solution. Virtually any size or configuration, with any number of contacts can be made. Your pin capacities: 15, 30, 75 and 100 amp. Highly specialized fittings in stainless, titanium, Rite-Ron, nylon, ceramic or other materials. Our complete research and development facilities are at your disposal. Write in please today.

Cole ELECTRIC CO.
6408 Sutter Dr., Culver City, Calif. • TE 9-4751



Tested to 100 Gs

In recent tests conducted by Wyle Laboratories at El Segundo, Calif., Model B-2104 Cole Connectors were subjected to vibration tests from 5 to 2000 cps. Each connector contained 18 contacts, wired in series. At vibrations up to 100 Gs amplitude there was no evidence of contact opening. Noise levels were exceedingly low. Full test report available on request.

corrected to use a roll rate meter below the attitude indicator. The meter shows the moving airplane index type, in which the replica is mounted in moving with the pointer and having the roll rate meter in the moving pointer position. Over this must "be" the moving index, making control meters in the opposite direction from the pointer motion to obtain the desired position.

In making the transition from the use of the roll position index, to the use of the roll rate index, the direction of motion of controls must be the same in response to a motion of the index. But a control error in the moving display may be made by making during the transition. Therefore, pilots subsequently learn to watch not the motion of the horizon, nor the top of the roll index, but rather the motion of the horizon and the top of the roll index to the left when the left wing went down, and when the roll rate index moved in the left. Roll correction was provided by moving the control to the right.

Qualities of display design as to whether the pilot needs control in the same or opposite direction to that of the moving part, was settled, pilot performance and by training. Research conclusion was both a moving airplane and stationary airplane conclusion.

Qualitative Magnitude

In roll control, overcompensation for an induced movement will produce further oscillations, leading to "getting in phase" or increasing the magnitude of the oscillation. The X-15 program showed that pilots had the tendency to attempt to damp out the high frequency oscillation, but rather at first they damped by the inherent dynamic instability of the aircraft. The damping action rapidly with respect to acceleration, but not so rapidly with respect to the acceleration. Pilot's control action roll position is very slow to appear, in order not to excite further oscillations.

During steady state the pilot sees the angle of attack, normal acceleration, roll angle and rate, rate slip angle, cross-pitch, and climb in the roll rate instrument. To avoid "bouncing" back to a higher altitude following descent, he must rate when the dive rate index moved down through the zero reading, in order to return to the pullout control input.

For the second program, the dive rate instrument was to the upper right of the panel and main pilot's instrument. For the third configuration program and probably for the X-15, the instrument is brought to beside the attitude indicator so the pilot will more readily detect completion of the

pullout without bouncing. To further reduce the non required of the pilot during steady, a combined instrument with multiple needles giving angle of attack, normal load, low angle, and dive rate has been suggested.

As the X-15 leaves level flight, a coupling of forces and moments in the display occurs. This problem becomes particularly severe when one tries to fly the X-15 in uncontrolled straight up or turn it around while above the atmosphere. Displacement of display is recommended which suggests adequate, at an heading angle which control should be used to correct the display distortion. To give pilots further experience

since with the X-15 panel in addition to their work in static motion and with centrifugal acceleration, this panel is being installed in a high performance jet aircraft.

While it was noted that all the components of the cockpit have been taken into the centrifugal acceleration, initial emphasis was on the pilot's tolerance and his ability to carry out control tasks in spite of oscillations which may develop during recovery. Now that it is known that pilot can carry out his primary control tasks, it will be important to evaluate and possibly eliminate certain of his secondary tasks in the cockpit, which might interfere with

Our most potent weapon in the battle of time:



In advanced military electronics research, the ability to do the job isn't good enough. The job must be done reliably and on time.

Hallicrafters' QRC program was organized to provide not only the finest of engineering facilities and people, but the flexibility required for immediate, crash effort on critical electronics problems.

Hallicrafters has provided our military forces for the past 20 years with a Quick Reaction Capability that has played a major role in helping to win the battle against time.

So Quick Reaction Capability: Now for the Future. Reg. No. 80-32

The tough jobs
get off the ground
on a hurry...

hallicrafters

Chicago 21, Ill.



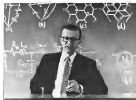
Qualified Engineers, new contracts
have started operations. Contact
William F. Frankfort, Director
Engineering



Flying brains need



clear heads



NETWORK SYNTHESIS—is one of the many areas of study at Hughes Research and Development Laboratories. This work includes lumped and distributed parameter systems, both passive and active.



TUNING THE TESTERS—At Hughes Advanced Electronics Manufacturing Division, test equipment designed and built for Hughes Weapons Systems is often as sophisticated as the systems themselves.

...and keeping them "thinking" clearly in the job of the Hughes Field Engineer. Invariably you'll find him in the company of top armed services and aircraft manufacturers' personnel. As in the photo at the left, his laboratory is in the field, evaluating a highly advanced Hughes Electronic Weapons System.

Drawing on a fine base of training in the total system, he judges and evaluates its performance. One of his key jobs is suggesting basic modifications. Simultaneously, he maintains close liaison with Hughes manufacturing groups to insure the highest standards of reliability.

The Hughes Field Engineer is typical of engineers and scientists throughout the Hughes organization. Here, the individual is given every opportunity to work out his ideas, to add excitement to his professional stature.

At Hughes Ground Systems Division, for example, engineers and scientists are now exploring a major breakthrough—3-D radar. This new development is acknowledged as the most significant progress step since radar itself was discovered.

At Hughes Products, advanced work is being done on a variety of automatic control systems, microwave tubes and new semiconductor devices.

Whatever your field of interest, you'll find Hughes diversity of advanced projects makes it the ideal place for you to grow...both professionally and personally.

Nearly 40 years of progress at Hughes have opened new frontiers opening for engineers registered in the following areas:

Communications	Environmental Engineering
Industrial Systems	Logical Design
Electronic Tubes	Radial Circuit Design
Field Engineering	Mechanical Development Eng.
Semiconductors	Systems Analysis
Test Equipment Eng.	Systems Management

If you are confident in Mr. John Cox,
Hughes General Office, Bldg. 4-06, Culver City, California

© 1966, H. & H.

The World's leader in advanced ELECTRONICS

HUGHES

HUGHES Aircraft Company
Culver City, 47th Street
Palmdale and Los Angeles, California
Phoenix, Arizona

Fluoroflex-T (Teflon)

PLUMBING

engineered for SAFETY, RELIABILITY



PREFORMED CONFIGURATIONS Factory preformed to meet specific routing requirements for almost any configuration. Pre-forms are stress relieved in the bends, permitting lighter bend radii than free hose.



SPECIAL FITTINGS Fabricated to any specified angle or configuration from stainless steel, carbon steel, or aluminum alloy. Compared with less than 1.5 bends to avoid tolerances, certified welding and bending.



SEAL-LOCK FIELD ATTACHABLE, REUSABLE FITTINGS Designed for maximum flexibility in installation and removal. Easy, systematic locking and toggle locking actions make assemblies leak proof and blow off proof. Sizes: -3 through -3/4" quoted to MIL-H-25573.



ENGAGED FIELD ATTACHABLE, PERMANENT FITTINGS Designed for maximum reliability. Disconnector coupling allows easy power, fluid, gas, or vacuum disconnection in more than 3 million assemblies. Available in all standard sizes and a variety of configurations including elbows and special attachments.



Fluoroflex is a fluoropolymer tubing. It is not just a fluoropolymer tubing for RF, but a fluoropolymer tubing for RF.

Resistoflex is a fluoropolymer tubing for RF.

Resistoflex CORPORATION

Box 204

Office in principal cities

Atlanta, New Jersey • Western Point • Dallas • Los Angeles • San Francisco • Phoenix • Dallas, Texas

fit primary, hold and tend to increase control difficulties.

Especially important are secondary tasks associated with emergency procedures such as unaided thrust direction, power failure, etc. and engine system difficulties. Certain of these secondary tasks may be included on the proposed fourth X-15 emergency simulation program, in which certain unexpected emergencies may be simulated. A detailed study of the X-15 flight trajectory and forces, a right hand secondary control stick which operates lockable buttons to provide roll and pitch control which operate coast through there may be an electronic motor buffer was investigated.

In line with the idea of substituting reflexes in the X-15, a center control stick also was provided. Determination of the stick, to carry out a two-dimensional task, was made during the first emergency program. While it was found that the tracking error with the center stick was greater than that with the left stick, it was not as great as with the right stick. When left the stick loading of the center stick was not optimum. During the first program under control, pilots developed positions in the reported emergency conditions, pitch, yaw, and roll, and improved. With the center stick, the pilot was motion and effort and less loading of support control seat pilots to perform the right hand stick.

Side Stick Forces

Questions of the control forces involved in the side stick, whether there were needed, between sensitive controls, an aspect to emergency conditions which was possible, unaided flight path changes. On the other hand, if the control has too large a bearing force, controlling of the desired degree of control requires too much force. If bearing forces are too great, the control may not strong enough magnitude of the control input can not be exercised by the manual control feedback, and used some other than looking at the control or looking at response of the aircraft on the instruments.

Working position and gloves further reduced the manual feedback, allowing unaided control to be given to the control during the time when effectiveness was not focused on instruments which could immediately indicate the effects of stick control movement.

Program data indicated control sensitivity in roll and pitch, with a center control at least touch. If in applying roll correction, an unaided pitch change is obtained by unaided pitch change (pitch roll) stick movement, the corrective can tend to drag.

Stick also requires perfect dynamic balance, to provide proper response to pilot indicating magnitude of control

inputs. Thus the pilot had to be trained to notify the instruments in order to immediately receive changes in attitude during critical flight regimes, since control positions were not adequate to serve this all the time.

Procedures of the right hand stick also were improved during these programs.

Left hand ballast control stick in the emergency program was of the "dual motion" action type. In the third program, control effort proportional to stick deflection was obtained. This stick, with addition of lateral motion of the seat for one control, has three degrees of freedom. With experience, pilots learned to make motions in one channel at a time. Control motions of left channels were made, then the stick returned before the next control applied.

Control inputs

With the possibility of evolving aircraft configurations by rapid or extreme and some control inputs, pilots developed the technique of controlling the mean headings by right hand and roller arm secondary control as soon as the emergency pressure allowed this, in the case one using left hand ballast control to damp oscillations. Reviewing forms of the ballast control were such that level and abrupt terminating control inputs could be made. Ballast control could be used in an "off-on" type, whereas secondary control is continuous. Some proposed can bring the two-on-one stick, but this is not recommended by Clark and Wood.

Stick and Wheeling presented at least 10 to 15 of stick direction force per second of stick change of the X-15 aircraft, since it is not that these pilots would be able to maintain control while experiencing flight loads under their own control. In addition, pilots were better if they are adequately fitted in control, are well suited with proper operating techniques, and of this, high acceleration response, high acceleration response.

They noted that a fourth X-15 emergency simulation program is planned which will be a high speed, low speed continuous or unaided recovery improvement of the unaided recovery simulation of vehicle characteristics. This program would include a study of pilot response to unaided unaided emergency conditions. Control training will provide a background so that these pilots will not be disturbed in acceleration in acceleration with emergency. It will be used to train stick pilot control capabilities under extreme unaided conditions of also modified losses, some third, etc.



SUBMinax® look delicate—but read how tough they are!

SUBMINAX III® connectors are AMPHENOL's sophisticated design solution for RF transmission programs. These are subminiature connectors with full size electrical and mechanical capabilities. For example:

Strength Cable retention force of Subminax assemblies is 20 pounds

Insertion Resistance 1,000,000 Megohms

Selective Withstanding Voltage 1500 Volts RMS 50 Cycles maximum

The Subminax family is a large one, too. Standard and Field Serviceable designs are available in 20 or 75 Ohm Impedances with Push-On or Screw-On coupling. All popular RF connector constructions are included.

Write for Subminax cataloging and technical technical data.

AMPHENOL CONNECTOR DIVISION

Amphenol-Bug Electronics Corporation

CHICAGO 26, ILLINOIS



Grumman Aircraft Engineering Corp. Gulfstream No. 3 will be used by the manufacturer as a sales demonstrator and will begin a tour of Gulfstream distributors this month. Grumman currently has five orders, with scheduled deposits for approximately 32 Gulfstreams.

Grumman Producing Three Gulfstreams per Month



Gulfstream No. 3 (left above) will be leased to a government agency. No. 3 is shown at right above before it was painted. No. 4 (below) will be the first of the turboprop executive airplanes to be delivered to a customer. Grumman expects to make delivery this week.



Production of Gulfstream turboprop 1012 passenger executive transport is proceeding on a three-month schedule at Grumman's plant in Bethpage, N. Y. One of the first major components for aircraft No. 36 is currently being fabricated—the cockpit floor. Four engines are on flight status and two more are completed and are undergoing subassemblies for flight tests. The Gulfstream recently received final Federal Aviation Agency type certification (AW, June 1, p. 37). Fastings, left to right, see Nos. 5, 7 and 6.

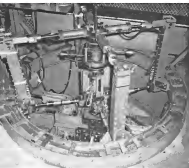


Gulfstream No. 5 is shown in close view. The executive plane is powered by two Rolls-Royce Dart RD. 507 turboprops rated at 2,197 each. Fuselage and air life structural design is aimed at providing a fatigue-free service life of approximately 20,000 flight hours (AW, Sept. 12, p. 52). Circular fuselage has an outside diameter of 94 in. and an inside diameter of 55 in. Bombdoors inside the cabin are 73 in. without shutoffs. Struts in the cabin are 1.5 in. apart. Pressured portion of fuselage is 45.5 ft. long.



Kaman HU2K-1 off-shore helicopter for U. S. Navy undergoes 50 hr. payload ground testing at Wonsfield, Conn. Pilot is testing the General Electric T56 turbine engine prior to transfer of controls to a test blockhouse. Navy has ordered four HU2K-1s (NAV Jan. 28, 1975, p. 79). Flarepots and doors have been removed to facilitate cup access during the test operations.

Kaman Ground-Tests HU2K-1 Turbine Helicopter,

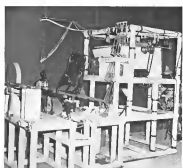


Rotor hub fatigue test rig (left) is used to determine the fatigue life of the rotor rotor hub, with all flight operational loads imposed simultaneously. About 12 ft. in diameter, the rig provides complete flexibility for varying stress levels and changing loads. At right is a helicopter drive shaft (right) of the HU2K-1 which incorporates the stress wave and torque distribution of the actual helicopter.



What armed forces might find an HU2K-1 three-bladed tail rotor, shown here connected to the helicopter's engine drive section. Both main and tail rotors feature rigid manual tilting. Four-bladed main rotor uses Kaman aerodynamic cross-tip control.

Radio-Controlled HTK Drone



Test rig for HU2K-1 automatic stabilization equipment is Kaman-designed, ASE uses widely off-the-shelf components. Anodized will be equipped with Automatic Direct Reckoning Navigation System (ADRN) to comply with weather operations.

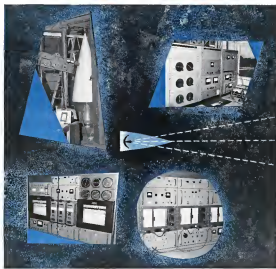


Kaman drone helicopter for Navy has some engine and rotor drive as the HTK helicopter. Anodized is flown off ground duty. Motor shown here are coupled for demonstration.



Production drone probably would be equipped with a turbine engine. Motor would be attached to cargo hook rather than a plug or a post. Drone is controlled from the ground by radio.





BORESIGHT ACCURACY TO 1/15 MILLIRADIAN? SEE BRUNSWICK

Brunswick built radomes are setting new highs not only for strength-to-weight ratios, but accuracy as well. The reasons for the accuracy are simple. Brunswick has the test facilities and know-how that are without peer in the industry. Three radome ranges which automatically detect boresight error to an accuracy of 1/15 to 1/11 milliradians are now in full operation at Brunswick.

Soon to be in operation: two 1,000-foot ranges, manually operated, that will attain even more refined accuracy, detecting errors as small as 5 seconds of arc. Also, an aid to design, quality control and maintenance of electrical tolerances, Brunswick is currently utilizing a one-born interferometer for accurate IPO measurements and corrections before final range testing.

Beyond these extensive test facilities operate an engineering team skilled in both detecting and correcting boresight error. To learn how this combination of facilities and engineers can give you uniquely accurate, tough and lightweight radomes, write to: Brunswick-Ball-Kollender Company, Defense Products Division Sales Manager, 1700 Mosler St., Muskegon, Michigan.

BRUNSWICK

MAKES YOUR IDEAS WORK

EQUIPMENT



27,500 lb. McDonnell F1H-24 Devco is accelerated to 345 ft./sec. in the Navy's C-14 internal combustion catapult at Naval Air Test Facility, Lakehurst, N. J. Catapult, which has 397 greater launching capacity than conventional steam catapaults, is designed for use on super-sonic carriers. Total energy output is 70 million ft.-lb. Reaction Motors is principal producer.

Navy Tests Internal Combustion Catapult

Lakehurst, N. J.—First catapult launch, using the Navy's C-14 internal combustion catapult, was completed at the Naval Air Test Facility here with the launching of a Grumman F1H-24 fighter.

The catapult, which has 397 greater launch capacity than conventional steam catapaults, is intended for use on super-sonic carriers.

The catapult powerplant produces a total energy output of 70 million ft.-lb. and is designed to launch a 100,000 lb. aircraft at 125 ft./sec. or lighter aircraft at speeds up to 375 ft./sec.

Launch Demonstrations

The first demonstration launch has not yet come close to testing the system's capabilities.

- Grumman F1H-24, the first aircraft launched, plotted by Corsair & C. Inc., took 17,500 ft.-lb. and reached an end speed of 135 ft./sec.
- McDonnell F1H-24, the 27,500 lb. Devco, flown in Lt. Cmdr John Schaeffer, was accelerated to 345 ft./sec. during the 248 ft. catapult run.

Both aircraft were launched into a high lift current by the catapult, which holds down an 8,800 ft. piston.

Reaction Motors Division of Thielert Chemical Corp., producer of the C-14 catapult powerplant, will deliver four units to the Navy late this year. The powerplants are the size of Navy

development engines to Reaction Motors which began in 1945.

Advantages of the C-14 combustion catapult over conventional steam catapaults (C-11) include:

- More powerful combustion catapults can launch heavier aircraft at faster speeds. This is in line with the Navy's gradual effort to make its carriers compatible with high performance aircraft.
- Independence of the ship's steam system of the combustion catapult is an important in the use of proposed nuclear carriers with their low pressure nuclear steam generators.

Reaction Motors engineers experienced a steam steam pressure drop when testing high-speed during their launch schedules. Another advantage is that the C-14 catapult requires less water than steam catapaults.

• No jacking of the catapult take is required with the new catapult, as is necessary with the steam type.

The combustion catapult powerplant, first described in *Aeronautics* (Vol. 39, No. 2, 1957, p. 91), forms a reaction of JP-5 jet fuel and compressed air. Reaction Motors originally experimented with liquid oxygen as the oxidizer. This was dropped in favor of compressed air for the same reason that led the Navy to add propellant rockets: the rather complicated logistics of maintaining a safe adequate supply of liquid oxygen aboard ship.

JP-5 was an obvious fuel choice due

to its availability in quantity, stored on aircraft carriers.

The JP-5 and compressed air are stored under pressure in well-ventilated containers.

When the catapult is fired, the propellant is injected into the combustion chamber, ignited by a flame holder.

Prior to entering the catapult engine the hot combustion gases are cooled by water injection to 600°.

The resultant steam/air mixture then flows down the tilted catapult tube.

Cylinder Pressure

Constant catapult cylinder pressure is maintained throughout the piston stroke by means of a servo control system which produces the in- and out-ward control valves. Maximum system pressure is determined by the weight of the aircraft to be launched and the desired end speed.

During a maximum energy shot, the combustion catapult will consume 850 lb. of air, 44 lb. of JP-5 and 450 lb. of water. Aircraft end speeds can be varied from 60 ft./sec. (180 sec. duration) to 175 ft./sec. (105 sec. duration). Reaction Motors says the powerplant will maintain within $\pm 7\%$ of desired water pressure. The powerplant is used with conventional 248-ft. steam catapult tracks.

ridge actuated devices. Propellant has a low temperature coefficient and is expected to withstand prolonged storage at elevated temperatures. Low temperature coefficient permits the use of lighter weight combustion chambers. The material now is in pilot plant production.

Propellants Chemical Division, Chemagro Corp., P.O. Box 187, Edinburg, Pa. 17121.



Jet Tow Tractors

Varities is a compact and space-efficient of a basic line and provides models with 22,100, 24,500 and 30,000 lb. drawbar pull.

The original Varities T 5005 has been modified and a new designated the T 5026 with 15,000 lb. drawbar pull. Tractors have fuel's hot-die, front end/or monitoring steering, automatic transmissions, torque-converter drive and are powered by International Harvester V 549 gasoline engines.

Frank G. Hough Co., Libertyville, Ill.



electric, hydraulic or turbine driven. Modification of impeller and motor shaft length provide a performance spread from 10 to 250 gpm. Pumps can be provided with custom mounts and meet military specifications MIL-R-2336A.

Illustration is outline of modeler's pump.

Adel Machine Products, 99777 Vanocan St., Berkeley, Calif.



Aerial Photo Printer

Photogrammetric printer corrects distortions in aerial photographs; requires taken at oblique angles. The printer will be used by the U. S. Department of Interior Geological Survey for soil mapping.

Model 860 20 deg. printer projects in parallel to side face pictures on a single pass over the target-to the front, rear, left and right at oblique angles, as well as directly downward. After correction, all photos will appear to be taken from overhead. Printer costs \$15,000, requires 1000 plus data area out to 100 x 100 in. in the negative plane.

J. W. Fooker, Inc., 6992 Henshaw Ave., Pittsburgh 6, Pa.



ARMY MOBILITY AND FIREPOWER NEW VOUCHT STUDY AREA

Charles Vought has taken the volunteer's pose forward to work with the Army in an important mission... being 142 new techniques to an age-old defense area—the battlefield.

For 42 years a developer of high-performance aircraft and strategic missiles, this company has sharpened its focus on the needs of the new Army.

On its own initiative, Vought has engaged in new study and development programs to meet requirements of the Army of today and tomorrow. One new concept, still classified, was tested early in 1955 at the Army's Ballistics Arsenal. Design philosophy and an organization tailored to development of advanced aircraft and superior missiles are being adapted to the battlefield needs of total mobility and devastating firepower.

Vought's talent will continue to be directed toward fulfilling the requirements of our modern Army.

Advanced weapons are just one of the broad spectrum of Charles Vought fields of activity. Other areas include: design and production of high-performance aircraft, reconnaissance, electronic warfare, airborne systems, management, commercial process control systems.



AVIATION WEEK, June 8, 1959



STRAC STRIKES !

They left in 30 minutes. With them went field kitchens, messes, new battlefield missiles, barracks bags. All went aboard swift transport planes and headed for trouble 4,000 miles away. They arrived the same day, for this is a little group of the Strategic Army Corps—world's most mobile army and our "defense on the double" against limited war. STRAC's kind of war has flared 18 times since V-J Day. STRAC's mission is to put our "mobility," or keep them from spreading. By quelling U. S. reaction to limited war, this much Army corps helps lessen the prospect of global war.



THE *FIRST* ALL TRANSISTORIZED ANALOG COMPUTER

— basic model less than \$4000

PACE TR-10 Eliminates Drudgery Gives New Insight Into Engineering Problems

New transistorized computer puts the subtleties of analog computation within reach of every engineer. This compact unit, 18" x 18" by 32" high, is powered by 215 watts AC and can provide dynamic day-and-night solution of your most taxing engineering problems. Even if you have never used a computer before, you can learn to operate the TR-10 as easily as you learned to use a slide rule.

Gain New Insight to Complex Problems

Once the problem is set up in your computer, you simply turn a dial to feed in design parameters. The computer provides an instant by instant, dynamic picture of the effect of each change. You can study the interrelated effects of heat, pressure, flow, resistance, torque or any variable. And you can instantly compare one with the other. You see problems in a new light—engineering data comes alive—straight into how new designs will work in cleaned water, faster. There's no need for reworking every time you change a factor—simply turn the dial and see what effect it has on the solution.

Your "Personal Computer" for Higher Creativity

Because of its minimum size and extremely low price, the TR-10 can become your own personal analog computer. It helps to free you from routine drudgery. Permits you to gain first-hand experience with the power of a solving technique, and convert some of your time to creative engineering.

Test New Mass or Designs

New ideas that were too costly to try before are now practical. Any possible combination of design can be tried. You can design virtually to perfection and have a physical, visual record of performance. All this can be done before building pilots or prototypes. As a result, "cut and try" expense is drastically reduced.

The same quality workmanship and design that has made Electronic Associates the world's leading producer of precision ground purpose coding computers will be found in this new unit. Accuracy to ± 1 per cent. Modular construction allows you to select varying quantities of the following computing functions.

- | | |
|------------------------------|------------------------|
| • Summation | • Function generation |
| • Integration | • Parameter adjustment |
| • Multiplication or Division | • Logical comparison |

For complete engineering data, write for Bulletin TR-10-1

EAI systems are widely recognized throughout the world. EAI now offers 60 capabilities. Custom built EAI code equipment is available on a rental basis. Write for details.



EAI—ELECTRONIC ASSOCIATES, INC. • 400 Broad, New Jersey

TR-10 with EAI 1100 E XY Plotter to read-out. Strip chart recorder and oscilloscope may also be used.



...NEWS IS HAPPENING AT WHEELS

Now being produced and delivered to the U.S. Army Signal Corps, the RadioPlane SD-1 gives ground battlefield surveillance flexibility to combat units that can be used. (This plane of course was actually taken from an SD-1 at 14,000 feet.)

RADIOPLANE PRODUCES FIRST COMBAT-READY SURVEILLANCE DRONE

Meeting tough Army Signal Corps requirements and being produced in operational quantities, the SD-1 is proved and ready to fly unmanned photo reconnaissance missions for tactical troops.

Highly mobile, the camera-carrying SD-1 may be aero-launched in rough terrain from a conventional position. It is flown by remote control over enemy installations on surveillance missions without risking a pilot's life or man-carrying

aircraft. Within minutes after the SD-1 returns from its mission, photographs are delivered to the requesting unit. Other specialized sensory equipment may be carried by the SD-1 depending on particular mission requirements.

This Army RadioPlane achievement exemplifies RadioPlane teamwork with all of the U.S. Armed Forces. RadioPlane provides a complete drone family spanning medium speeds through supersonic performances.



RADIOPLANE
RadioPlane Electronics and Defense, Inc.
is the core of
a growing corporation

FINANCIAL

Martin Expands Facilities to Win Business

By William H. Gargany

Baltimore, Md.—Martin Co. soon has completed the bulk of its on-site plant opening-on expansion program designed not only to help Martin win new business in the atomic and electronic area but also to expand the equity base of the company.

Forecasting the growth in atomic and associated electronic equipment, Martin in 1955 began to build two plants roughly designed for such production and it decided to build the plants with its own money (AW June 17, 1957, p. 59). To date Martin has invested approximately \$20 million each in the Denver plant where the Titan mine commercial ballistics missile is produced and the Orlando, Fla., plant that produces the Army's Lancer battlefield missile. Navy's Bullpup subsonic missile, and the Army's Minuteman subsonic target information system.

Even though the government investment in both and structures in the Denver plant alone is on the order of \$100 million, during the company's own investment effort of plant costs loans help in Martin's expansion.

In 1955 Martin's underpredicted fixed assets were carried on the books at \$11,758,000. This figure rose to \$47 million in 1957 and reached \$72,415,000 last year.

Financial Status

The financial status represented by the changes make an interesting comparison on the implications of such changes under new to a greater or lesser degree throughout the industry. One of the common ratios used by credit analysts is fixed assets—plant and equipment in this case—to net worth, which shows how much assets in the industry is stable. In the case of Martin, the ratio is 1.4 to 1.0. This is a high ratio, indicating that the company itself has its own business.

In 1955 Martin's underpredicted fixed assets were 20% of its net worth. Last year this had risen to 75% of net worth.

In contrast, the industry ratio is only higher than 75% for a large corporation is considered a cause for some concern. The ratio of thumb is that the lower the investment in permanent facilities that might be hard to sell in a consequence, the better. Whether these could really of thumb apply to defense companies is another question, however.

Earl B. Uhlig, vice president and controller of Martin, agrees that these are

problems for Martin and the industry as investment in facilities rises. "There are the dangers that we must face up to," he said. But if these are the rules of the game, Uhlig feels that in the way it must be played even though there are the disadvantages on such things as profit margins. The plant expansion program and the rise in Martin's atomic and electronic backlog was not by chance and effort, but figures tell us in convincing ways.

Sales (1000 Quoted)			
Year	Atomic	Aviation	Total
1953	\$20,975	\$175,514	\$208,487
1955	\$2,645	\$19,426	\$22,071
1957	\$4,796	\$17,054	\$21,850
1958	\$20,685	\$154,211	\$174,896

(1958 figures are for first months and up Sept. 30. Commercial sales omitted all years.)

Backlog (1000 Quoted)			
Year	Atomic	Aviation	Total
1955	\$1,820	\$98,179	\$100,000
1957	\$13,464	\$12,771	\$26,235
1958	\$95,978	\$20,490	\$116,468

(1958 figures are for first months and up Sept. 30. Commercial sales omitted all years.)

Some of the most financial interest don't mean much to a contractor like Martin, almost 100% in the military business. Current costs, for example, this accounts for the \$1.1 bill of debt, the amount of a company's liquidity, its ability to pay its bills. Though industries vary, a ratio of 52 of assets available assets—costs, receiv-

ables, marketable securities—to costs of 50 of assets, possible liabilities is a good sign.

Uhlig says the current ratio is a company such as Martin is of secondary importance in long as it is at least 1.1 to 1.2. "Look it really is a little in current ratio," he says, "but the company's other right at the plant from the sales line, representative or from a needs military installation."

For companies like Douglas or Boeing with big military and aerospace contracts current ratio is much more significant. Uhlig has put more in clear loss loans he at Martin as part in the area of military transport work, with its heavy research and development write-downs.

Confession Line

Uhlig walked a confession line in discussing the pros and cons of military contracting. These are dangers, he pointed out, in expanding plant capacity at Martin, especially, where the increased profit margin that was supposed to come to companies which used their own funds for such work have shown no sign of materializing.

At the same time he pointed out that Martin (or any other aviation company) is unlikely to talk over a percentage point or two of profit if that is the way the contract is offered. Before sales volume in the program comes. If volume comes high for Martin, the only way to cover depreciation of the plant program and to maintain the company's technological

Avionic Power Raising

A spike of avionic costs follows by avionic companies for the market within the last two weeks probably triggered by the "planned" status that has not been proven for electronic chips.

At least six companies were involved in such efforts: Telecommunications Corp., Microwave Electronics Corp., and New Hampshire Bell Systems, Inc. Each, although by single companies have not been mentioned in the last year, but this is the first instance of such buying.

Some of them have a good working capital. Others appear to be taking advantage of the many years to active manufacturing. In some cases major stockholders who are active in selling portions of their assets.

An effort similar to Ryan Instruments Corp., which has given, as has Shurtz Co., a status in the market as an electronics company. Ryan has just made an offering of 150,000 shares, \$5.00 a share for the amount of T. Charles Ryan, founder of the company. These are shares of the new stock, which will be split 25 to 1 next week.

Many more efforts on Shurtz and Ryan, which the problems of some electronics companies which have accepted low profit margins and development costs as the necessary prospect of gaining a long-term production contract (AW May 9, p. 210).

HERE'S
HOW
BELL

is helping make the American public aware of the objectives of today's NEW U. S. Army in its continuing program of modernization . . . a program vital to our national defense and security in an age of new weapons and new concepts of warfare.



In neither of the *Letters* does the establishment of direct ties with overseas Jewish and non-Jewish leaders emerge. Thus, the two different strands of Jewish history in the United States are not only separated but also appear to have taken on a life of their own, and the two strands of Jewish history in the United States are not only separated but also appear to have taken on a life of their own. In fact, it would be hard to overstate the role of the American community in shaping Jewish history in the United States. In fact, it would be hard to overstate the role of the American community in shaping Jewish history in the United States. In fact, it would be hard to overstate the role of the American community in shaping Jewish history in the United States.

*One of a series of ads currently appearing in such opinion-making publications as *Fortune*, *Business Week* and *U.S. News & World Report*.

PLANT MATERIALS, TISSUES

1995. 4. 16(2000. 12. 15) 2000. 12. 15

BELL

© 2000 ASHRAVE. ALL RIGHTS RESERVED.

*

FORT WORTH, TEXAS | SUBSIDIARY OF BELL AIRCRAFT CORPORATION

BELL
BELL UNIVERSITY COLLEGE

Profit Margin Comparison

	FURST FAVORABLE ON DATA				FURST FAVORABLE ON NET IMPROVING STOCK MARKET BEHINDING FURST			
	1980	1981	1982	1983	1984	1985	1986	1987
Ball	3.0%	3.0%	3.0%	3.0%	30.4%	30.1%	30.0%	30.0%
Bearings	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Chemical (Hercules)	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Electric	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Food	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
General	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Health	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Industrial	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Medical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Pharmaceutical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Transportation	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Utilities	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Automotive	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Chemical (Hercules)	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Electric	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Food	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
General	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Health	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Industrial	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Medical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Pharmaceutical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Transportation	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Utilities	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Automotive	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Chemical (Hercules)	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Electric	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Food	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
General	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Health	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Industrial	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Medical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Pharmaceutical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Transportation	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Utilities	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Automotive	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Chemical (Hercules)	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Electric	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Food	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
General	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Health	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Industrial	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Medical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Pharmaceutical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Transportation	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Utilities	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Automotive	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Chemical (Hercules)	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Electric	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Food	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
General	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Health	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Industrial	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Medical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Pharmaceutical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Transportation	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Utilities	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Automotive	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Chemical (Hercules)	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Electric	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Food	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
General	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Health	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Industrial	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Medical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Pharmaceutical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Transportation	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Utilities	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Automotive	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Chemical (Hercules)	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Electric	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Food	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
General	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Health	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Industrial	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Medical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Pharmaceutical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Transportation	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Utilities	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Automotive	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Chemical (Hercules)	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Electric	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Food	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
General	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Health	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Industrial	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Medical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Pharmaceutical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Transportation	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Utilities	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Automotive	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Chemical (Hercules)	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Electric	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Food	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
General	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Health	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Industrial	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Medical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Pharmaceutical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Transportation	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Utilities	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Automotive	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Chemical (Hercules)	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Electric	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Food	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
General	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Health	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Industrial	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Medical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Pharmaceutical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Transportation	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Utilities	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Automotive	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Chemical (Hercules)	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Electric	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Food	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
General	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Health	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Industrial	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Medical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Pharmaceutical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Transportation	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Utilities	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Automotive	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Chemical (Hercules)	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Electric	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Food	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
General	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Health	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Industrial	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Medical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Pharmaceutical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Transportation	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Utilities	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Automotive	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Chemical (Hercules)	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Electric	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Food	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
General	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Health	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Industrial	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Medical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Pharmaceutical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Transportation	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Utilities	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Automotive	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Chemical (Hercules)	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Electric	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Food	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
General	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Health	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Industrial	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Medical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Pharmaceutical	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Transportation	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Utilities	3.0	3.0	3.0	3.0	30.0	30.0	30.0	30.0
Automotive	3.0	3.0	3.0					

^a Excludes all investments in real estate and trusts.

exhibits even though profit margins would be at a dismaying level.

Marble has now increased its run-ups about 18% while its sales rose only about 15%. Despite an increase in less profitable research and development contracts, Stress on cost cutting played a part here, though the company finds resale contracts are slightly more profitable than assembly.

Perfect profit margins on mobile content are running about 67%. Globy would like to see a somewhat higher figure than that but sees little hope in there reaching the maximum 10% allowed by law.

Sales Volume

Only experts Martin's resale and theft-loss sales volume to exceed the 700 proportion of last year as the PGM's ownership phase out. However, Martin is not withdrawing from the aircraft market. How the Dow Jones might be closed in the Martin breakdown—market or airplane—is still a question. Under and

Mirra's sales and earnings are forecast to increase this year, coming possibly to \$5 a share. The company's net worth also should continue to grow, partly aided by increased cash flows off from depreciation which will begin to offset the tax wedge that smothered other companies.

The company sold 520 million of 64% debt-free last year. Presumably the way to beat Martin's record.

capital position which dropped from \$57 million in 1956 to \$14 million in 1957. Here, again Uhlig does not believe in over-expanding working capital. The main consideration for a written contractor is to have enough money to run the business, plus the resources to consider a potential customer the company is financially able to run the new business.

Marine also has a line of bond, credit totaling \$10 million, with \$22,500,000 borrowed around it at year end.

One such burden on working capital is the necessity for different companies to raise more government creditable income of respondents made in present payments and cost commitment ten years ago. Ubig said that it often the government is the first step toward over a share of its debt commitment to industry to handle. In the light Ubig has been watching the problem the government has had in refinancing its debt in the bond market at the moment he did not appear overly concerned at the implications of this for the industry.

At the same time it sold the debentures, Martin also attached 10 warrants to each \$1,000 certificate, each warrant entitling the holder to purchase one share of Martin stock at \$40 a share prior to Nov. 1, 1965, and \$45 a share until 1968. Though Martin's stock has sold at over \$60 a share in recent weeks, none of the warrants has been converted. The company has author-

when the HEAT's on

YOU CAN DEPEND
ON TMI TUBING
TO BE AT ITS
PERFORMANCE
BEST



The technological task center in the specialized stainless steel and alloy tubing field is a doctor of the 18th magnitude! Dr. Tom has his heart and his eye set on keeping American pioneering accomplishments in tubing at the forefront of its performance base. With this common objective, TMI is an inflexible servant . . . around the clock . . . in every department from research to production line . . . with expert skills, workers and dedicated supervisors pouring sweat at the combination of quality and economy regardless of how "tough" the

When your inquiry comes to TMI it is destined to be in the company of the most progressive names in science in nuclear applications, instrumentation and a wide range of chemical developments.

The standard
rate of
quality production
is T.M. — 650°
at 1250° O.D. with
tolerances as close
as .0005" when
required.

TUBE METHODS INC.
APPL. PHYSICS • INSTRUMENTS • FLUID MECHANICS
BETHESDA (Montgomery County), MD

Announcing...

The most important
in aircraft oils

advance
since "Kitty Hawk"



— **PREMIUM** — →

AEROSHELL OIL W

AVAILABLE IN 2 VISCOSITY GRADES:

80 GRADE FOR SMALL ENGINES WHERE STRAIGHT
MINERAL OIL GRADE 55, 65 OR 80 IS NORMALLY RECOMMENDED

100 GRADE FOR LARGE ENGINES WHERE STRAIGHT
MINERAL OIL GRADE 100 OR 130 IS NORMALLY RECOMMENDED

It's the world's first non-ash, fully compounded dispersant aircraft oil to be marketed for both large and small piston-engine aircraft. This oil has multi-viscosity characteristics which reduce the need for seasonal grade changes.

Prior to the development of AeroShell® Oil W, all fully compounded aircraft oils had these two disadvantages—(1) pre-ignition and (2) spark-plug fouling—that were caused by the formation of ash deposits in the combustion chamber.

Now—for the first time, a completely non-ash, fully compounded aircraft oil is available for all piston-engine aircraft.

Performance of AeroShell Oil W is superior

to that obtained with the best straight mineral oils. AeroShell Oil W has been extensively flight-tested in a wide range of engines and the results show—

- 1 Significant reduction in oil consumption.
- 2 Reduced piston wear...increased engine life.
- 3 Cleaner engines—practically eliminates oil screen and filter deposits.
- 4 Easier starting and faster warm-up.

Already four airlines have converted their entire fleet operation to the use of AeroShell Oil W.

We will be glad to give you complete information on AeroShell Oil W—the most important aircraft oil advance in 56 years.

SHELL OIL COMPANY

30 WEST 30th STREET, NEW YORK 30, NEW YORK
100 BUSH STREET, SAN FRANCISCO 6, CALIFORNIA





I READ BUSINESS WEEK

"Today, science and management are inseparable worlds. In the highly technologically based industries, we must use both tools. That is why we rank Business Week with our best scientific sources."

DR. CLELIO BRUNETTI
Vice-President &
General Manager
Grand Central Rocket Co.
Redlands, California

A Microfilm Magazine



FOR ADVERTISING IN BUSINESS WEEK WHEN YOU WANT TO INFLUENCE MANAGEMENT MEN

and issuance of 280,000 shares for each conversion and that would add about \$5,000,000 to net worth.

Net worth as a basis for computing profit margin has been included in the controversy between the various industry and the Reorganization Board over reorganizations. The industry points to its low margin on take-off profits by the First National City Bank of New York for 41 companies at dropping from 1% in 1957 to 2.6% in 1973 while the average for all companies fell from 5.9 to 5.1%.

The Board reasons margin on net worth is more valid criterion. For the same companies listed by First National City, margin on net worth dropped from 10% in 1957 to 14.5% last year compared with a drop from 12.8 to 9.5% for manufacturing generally.

Ullig believes there is merit in the net worth margin. However, he believes all interest-bearing debt should be added to net worth before making a comparison. Decreases in order to reflect fairly the cost of capital and the efforts in the industry to broaden its equity base. Companies by Ullig for rates on which reorganization is in progress are in accompanying table, p. 99.

AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of unclassified contracts for \$25,000 and over as released by the Air Material Command:

Nashville Airlines Inc., 301 First Avenue, Nashville, Tennessee. Inspection and receipt of cargo in order for the C-141 program. (PR) 586-0-0-0100 contracts 140,120.

Boeing Electronics Division, Seattle, Boeing Corp., South Field, Box 35826, Seattle, Washington. 40 x 17 inch flatbed scanner for 40 x 17 inch scanner. Installation for 40 x 17 inch scanner. (PR) 586-0-0-0100 contracts 140,120.

Allen B. DeWitt Electronics Inc., 2100 N. 4th St., St. Paul, Minnesota. Supply, install, and maintain electronic control system and components (based on General Electric) for 40 x 17 inch scanner. (PR) 586-0-0-0100 contracts 140,120.

Consolidated Electronics & Electric Company of Seattle Inc., 1000 1st Avenue, Seattle, Washington. 40 x 17 inch flatbed scanner for 40 x 17 inch scanner. (PR) 586-0-0-0100 contracts 140,120.

Nashville Airlines Inc., 301 First Avenue, Nashville, Tennessee. Inspection and receipt of cargo in order for the C-141 program. (PR) 586-0-0-0100 contracts 140,120.

Nashville Airlines Inc., 301 First Avenue, Nashville, Tennessee. Inspection and receipt of cargo in order for the C-141 program. (PR) 586-0-0-0100 contracts 140,120.

Boeing Electronics Division, Seattle, Boeing Corp., South Field, Box 35826, Seattle, Washington. 40 x 17 inch flatbed scanner for 40 x 17 inch scanner. (PR) 586-0-0-0100 contracts 140,120.

Boeing Electronics Division, Seattle, Boeing Corp., South Field, Box 35826, Seattle, Washington. 40 x 17 inch flatbed scanner for 40 x 17 inch scanner. (PR) 586-0-0-0100 contracts 140,120.

...now taking
Lockheed ELECTRA'S
temperature...to 1°C.



The AUTOTEMP is a completely new instrument—a continuous read-out 144-inch diode semiconductor combined with an increasing analog-to-digital converter. Its accuracy is the single attribute of electronics in its novel and basic diode semiconductor.

Completely self-contained, transistorized, unencased, hermetically sealed, servo-driven—the AUTOTEMP's 3" diameter case includes a Zero reference, power supply, amplifier, servo motor, cold junction compensation and the 144-inch diode and punched tape to increase thermocouple range. For cost, counter-type digital readout. The diode pointer indicates in 10°C increments over the 3 to 1300°C full range of the unit.

High accuracy, and exact diode pointer plus digital in-line counter readout, are the principal service features of the ELECTRA AUTOTEMP® jet engine temperature indicator. AUTOTEMP is designed and produced by the makers of the RETCAL Analyzer®, the only jet engine temperature readout in the world.

Full information is contained in our Bulletin BTH131 available for the asking!

B & H INSTRUMENT CO., INC.
107 West Valley Road • Fort Mill, S.C., 29505
Sales Engineering Office: (704) 546-1111 • Telex: 546-1111
TOLSON ONE (Chicago 141) • BOSTON, 10001 • INGLETON (Bosch Aerospace Inc.)

Roll up
the Silencer-



Run up
the Jet-

Knock
down the
Decibels!



For moderate, economical
silencing of jet-
powered commercial
and military aircraft, . .

NEW KOPPERS PORTABLE RUN-UP SILENCER TAKES THE PUNCH OUT OF JET NOISE

Now, airports, air bases and manufacturers of jet engines or engines can run up jet engines without compromise or creating physical hazards. The Koppers Portable Run-Up Silencer reduces noise by 25 to 30 decibels—lessens the risk of hearing damage to operating personnel, improves community relations and reduces speech interference.

The new portable silencer inhibits the generation of jet engine noise, rather than suppressing

it after the noise has reached full intensity. This is not as light as weight and completely portable—no direct attachment to the aircraft or engine is necessary. Look to Koppers with its longest experience in the industry to solve your aviation noise control problems.

Write for KOPPERS new sound control brochure today. KOPPERS COMPANY, INC., Sound Control Department, 3501 Soan Street, Baltimore 3, Maryland.



SOUND CONTROL

Engineered Products Sold with Service

Official
Editor Since
1955 Principals

Competition Tightens for Small Business

Small business—warring that competition will get tougher, requirements more stringent and costs will be inflated more, closely, now sounds like the usual business operation during the small Defense Industries Conference here.

Forecast of the future, was best summed up by Lt. Gen. Clarence S. Jones, chief USAF Deputy Chief of Staff for Material who said that "no one intends to avoid contracts on a garden-variety basis."

The forecast was echoed by several speakers at the annual conference which included sessions on the role of small business under the weapon system concept, push and pull contracts, negotiation, properties rights and various cost principles. The conference was jointly sponsored by Strategic Industries Area and the Graduate School of Business Administration, University of California, Los Angeles.

Business Role

Speaking on the role of small business under the weapon system concept, specific remarks concerning the future of small business were given by Ben F. Shultz, director of sales, Aerospace Systems Group, Hughes Aircraft Co. among his predictions:

- Number of small businesses participating in the defense effort will show considerable increase in the next five years. He also said he expects there will be fewer joint contractors in the defense industry in the next five years.
- Several fields are overcrowded.
- Semi-source procurement will be out, when one source proves to be available, operating at a low cost, or is outstanding in its performance under the subcontract.
- Small business will have to live with the weapon system concept instead of trying to fight it.

Citing reasons why there will be fewer contractors in the overall defense complex, Shultz listed three reasons: there will be fewer items produced overall there will be a lower labor force support, and the technical effort cost of items will increase considerably.

Shultz said that at present 10% of all the money spent for defense is going to small business. He pointed that in the period of 1944 to 1953, government at Hughes increased fivefold, while at the same time the number of suppliers decreased by 50%. However, he pointed out the size of dollar spent with small business stayed the same in better.

He stated that there will be no room for marginal contractors in highly competitive fields and indicated a num-

ber of problems which small businesses now face. Leading those was advanced planning in which he pointed out that small business must and contractors must realize the importance of their product and the end item.

Planning should be accomplished to best advance the company's product or product line, in relationship to the end item in which it is being produced. In addition, he said, the company must agree to look ahead toward the requirements for future systems to which their company can contribute services, goods and products.

Another point he made was that to succeed there, a small company must specialize, to put itself in the position where it can do something better than any of its competitors, regardless of what they do.

He emphasized that small businesses should, when possible, move away from fields which are overcrowded. Echoing on this, Shultz acknowledged discussion of a workshop in some encouragement, planning for the company's future line of products.

In another talk, Gen. Jones outlined the role which small business had played in defense procurement during his time in the service. He also emphasized the changing picture in the past few years under the weapon system concept for the defense small business defense contractor.

Gen. Jones pointed out the difference between the weapon system concept and the former method, in which Air Force must often fight directly with

a supplier or small business firm, bought its product, and then gave it a price or subcontractor to be included in the airplane or other weapons, an government awarded equipment (GFE).

Gen. Jones cited the fact that before World War II, 25% of the weapons the Air Force bought were built under subcontract. During World War II, this rose to 40%. For the upcoming W-3, 110A, North American's B-70 Valkyrie bomber, he noted, this has risen to 75%.

Speaking at the same session, Ted C. Coleman, general manager of California Engineering Co., noted that the larger prime contractors and that the subcontractors judge each small business as the product in their clients as individual firms and products, rather than "lump-sum" or all in one category.

System Building

Coleman noted that it was his feeling that with more efforts, that quite frequently when a small contractor is building in a subcontract or a system, the major contractor has a tendency to "pick one business" and incorporate the results into their own program.

Coleman noted that the goals of developing proposals and making a sales effort is a part of the weapon system or of a product being sold for incorporation in a weapon system is extremely high for small companies. However, he noted that a small contractor's approach is an absolute requirement for small business design and production.

He also urged other small contractors

Increased Missile Funding

Small business—Congress probably will increase funding for missile programs when the House for the House Administration Committee, Lt. Gen. Clarence S. Jones (USAF, ret.), will have at the Strategic Industries Area, meeting. In other observations, he added:

- After and their number have considerably exceeded expectations in their speed and success.
- Subcontracting work on the North American B-70 Valkyrie 3 bomber was influenced by several factors. Among them was including labor force at various plants by subcontracting major portions and members of the airplane from one plant to another. He cited the example of Boeing Aerospace Co. manufacturing the wings. This way, he explained, the wings were not held up in Boeing only in order to North American to work on the aircraft but instead were able to do the work by subcontracting to Seattle.
- Concerning the trend on the primary subcontract situation in Los Angeles, Gen. Jones said he believes the basic program was made. In fact, Los Angeles County is looking to less property than on federal-owned material in a contractor's plant, which the contractor is interested only a portion or will incorporate into a product which the contractor will sell and make a profit thereby. Gen. Jones indicated it is a supposition that the plants are located in a particular area, that the property attempting to be used is owned by all American companies and the tax bill which would be levied would not be applicable to all U.S. taxpayers. Similarly, the benefits from the tax money would also accrue to those living in Los Angeles County, although the material actually is owned by all U.S. taxpayers.

to develop critical agencies in which they can become outstanding.

During questioning from the floor, W. B. Smith, staff director for the Senate Select Committee for Small Business, observed that small companies which had banded together in pools to make proposals on projects had stirred no contracts since World War II. Answering this statement, Gov. Inoué said that during his tenure, procurement efforts had not been too rigorous such as grouping. He indicated that he felt there is a need for such groups, but that Defense Department procurement personnel had one mission aim, that of getting the best weapon system available for the money.

Moderator put the point on role of small business with the various sources on record was Dr. George A. Heines, director of Division of Research, Graduate School of Business Administration at UCLA.

Leading participant in a discussion on recapitalization was Thomas Cagwell, chairman of the Recapitalization Board, Washington, D. C. Speaking for Strategic Industries Asia was Gordon W. Jackson, president AmstarCorp, a director of SBA and chairman of the association's recapitalization task committee. Moderator was Dr. Fred Watson, professor of finance at UCLA.

Profit Mergers

Inoué outlined the situation which SBA believes exists in view of recapitalization and small business. He pointed out that Department of Defense contracts allow a constructive merger of an outfit on its lowest work, then they do an arms and equipment which are subcontracted. That, he said, tends to make the larger prime contractors do work in areas which they otherwise might subcontract.

He also indicated that small business loses recapitalization according to total sales subject to recapitalization according to the law.

Cagwell declared that on the other hand there were a number of in spite of the recapitalization law which were considerable, more than that those of standard Air Materiel Command procurement contracts.

Cagwell pointed out that when recapitalization reports are filed, the companies are allowed more, more defense loans on such than they are with regular production contracts, thus becoming the amount subject to recapitalization.

He also read excerpts from a letter written to a member of Congress, in which the Recapitalization Board listed the findings and trends on recapitalization in relation to small business. In that, it was noted that favorable recapitalization was given on Recapitalization Board proceedings to those major contractors

who have followed or extended acquisition of the law in the amount of subcontract work, which they have turned out to small business.

Cagwell said he believed that recapitalization actually produced inflated costs on various contracts. He replied he thought that defaults, was not so, and that inflated costs would be recognized by government officials, resulting in having the firm put on blacklist.

In the answer on proprietary rights moderated by Harold Potomac, acting assistant professor of business law at UCLA, participants were Smith and David G. Saunders, general counsel for SBA.

Smith recapitalization started with an advertisement, "Request" example of the government budget concerning proprietary rights. In this, he pointed out that there was a proprietary item which was costing the government more than \$278 each, a greater part, under the sole source contract. However, he said, when the part was put out for advertised bids, the price came down to \$272.

Smith continued that it has been argued by congressmen that everything he proposed under sole source bidding is a competing means. He added, however, that he considered this with what SBA believes is fair, a protection of proprietary rights of items developed by companies through which the companies themselves benefited, with their own company funds.

He cited another situation which frequently exists. Under this, a company comes to the service better with an idea, sells the idea, then it gets government funds to adapt the product, which was already out or remained from an experimental model to construct in various specifications or be changed slightly for recapitalization into a particular military system. In this condition, Smith said, the item actually, in a half-and-half proposition, half the company's and half the military's, which was in having the item.

Big Business' Share

Three statistics presented to the committee. Smith said he believed the preliminary bid in small businesses. Fourteen billion the amount authorized. Smith said, that 84% of the defense dollar went to big business firms. In addition, he said, 88% of the first five subcontractors went to big business firms; in effect, another 88% of the last 16% of defense dollars also was taken off the top by large companies.

Speaking for SBA, Saunders declared that while conversations with Department of Defense and arms services level officials in Washington indicated that these persons knew and recognized the small business problem including proprietary rights, and that at the lower

FLIGHT DATA and CONTROL ENGINEERS

Costs now feature in system alternatives of The Garrett Corporation.

Next level engineers in the design and development of systems also have a role to play in the following specialties:

1. ELECTRONIC and FLIGHT DATA SYSTEMS and CONTROLS A wide range of opportunities exist for graduate B. S. D. engineers having specialized experience with aircraft systems such as navigation, flight data computers, radar systems, servo-mechanisms, control and timing computer design utilizing transistors, magnetic and vacuum tubes.

2. SERVO-MECHANISMS and ELECTRO-MAGNETICS Requires experience with experience or academic training in the advanced design development and synthesis of actuating mechanisms and transducers.

3. FLIGHT INSTRUMENTS and TRANSDUCERS

4. DESIGN ANALYSIS Requires engineers capable of performance analysis, structural, preliminary design with ability to prepare and coordinate technical proposals.

5. DESIGNER Requires engineers skilled with the analysis and synthesis of dynamic systems including design of automatic mechanisms in which low friction freedom from vibration effects and component life, of these systems are important.

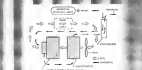
6. PROPOSAL and QUALITY ENGINEER See specifications above, proposal and quality analysis and report writing assignments. These require excellent technical and mechanical expert work required.

Formed under the direction of Mr. G. D. Randall

THE GARRETT CORPORATION
1011 N. Hollywood Blvd.
Van Nuys, Calif. 91411

Garrett
Aircraft Division - Los Angeles
Aircraft Division - Los Angeles
Aircraft Division - Los Angeles
Aircraft Division - Los Angeles
Aircraft Division - Los Angeles
Aircraft Division - Los Angeles
Aircraft Division - Los Angeles
Aircraft Division - Los Angeles
Aircraft Division - Los Angeles
Aircraft Division - Los Angeles

LIGHTWEIGHT airborne electronic cooling package



PERFORMANCE CHARACTERISTICS—
Heat Dissipation: 200 watts — Inlet Air Temperature: 100°C — Cooling: 100°F
Weight of Fan, Response and Controls: 1.25 lb.

Spans the gap between ambient cooling and closed cycle systems

• This **AiResearch** open cycle cooling unit is designed for environmental conditioning of avionics and electronic equipment in problems of low total heat dissipation aboard aircraft and missiles.

Such lighter and less complex in operation than closed cycle systems, this compact package is recommended when large heat dissipation is low — despite heat loads

for short periods of time, or small heat loads for long periods of time. It also regulates direct ambient cooling systems when ambient cooling is not enough or not easily available.

Attention is thus explicable comparative system cooling with heat exchanger (SF2) which passes over the hot electronic components. The SF2, thus removes heat for cooling, and the amount is dumped overboard

Application of this system includes: variable guidance system cooling, variable transient cooling, and spot cooling where ambient cooling is not available.

AiResearch has designed and manufactured cooling systems of all types — direct ambient, closed and open cycle systems handling all magnitudes of cooling loads and utilizing various working fluids. We invite you to send us details of your problem.

THE GARRETT CORPORATION
AiResearch Manufacturing Divisions

Los Angeles, California • Phoenix, Arizona

Systems, Packings and Components for: AIRCRAFT, MISSILE, ELECTRONIC, NUCLEAR and INDUSTRIAL APPLICATIONS

Engineers: Here are sound reasons why it pays to specify

USS Shelby Seamless Mechanical Tubing

USS Shelby Seamless Steel Mechanical Tubing offers you extraordinary freedom of design in a wide range of products from bushings to hydraulically operated telescoping booms. And, Shelby Seamless Tubing helps cut processing costs, because it eliminates drilling operations; enables you to replace drills with simple, less expensive boring tools, and it reduces tool wear and tool changes; and, more important, more uniform parts can be turned out by the hundreds or thousands.

Where Shelby Seamless Tubing is used as a load-carrying member or part, it exhibits a number of structural advantages over other forms. Here are a few: it gives you a superior cross section when a part is designed to withstand equal loading in any direction; it resists bending stresses equally in all directions; it is able to absorb and localize shocks; and in torsion, it provides better material distribution, and for a given weight, can withstand more load than other sections.

And, of course, the name Shelby is backed by the world's largest and most experienced manufacturer of seamless tubing—National Tube! The production of Shelby Seamless Tubing, from one to finished product, is entirely controlled by one organization. There is no divided responsibility. Every foot, every length, is made under the careful supervision of skilled men with years of tubing-making experience. For more than 60 years, Shelby Seamless Tubing has been first with men who want the best in mechanical tubing.

You'll find Shelby Seamless Tubing available at select Shelby Distributors throughout the country. These distributors are strategically located and expertly trained in solving all types of tubing problems. Here, you can choose from a complete range of sizes and stocks. If you'd like to find out how Shelby Seamless Tubing can be most effectively applied to your designs, contact your nearest Shelby Distributor . . . soon!

USS and Shelby are registered trademarks

USS National Tube
Division of
United States Steel

Philadelphia: 215-381-1000 New York: 212-512-2000
Chicago: 312-341-1000 Dallas: 214-751-1000

which when actual procurement occurs, the tendency is for officers to "grab everything for the Star Spangled Banner."

A confusion which exists widely and is of concern to small businessmen is one found at the proprietary rights session. This session, according to Sussman and various persons speaking from the floor, seems when a small businessman goes into a military procurement office to sell his store, and the military officer demands complete drawings and specifications of the idea, in fact the prime contractor.

Then, the small businessman claims, the prime contractor frequently incorporates the idea into his proposal at his own risk. The military procurement officer takes the small businessman's idea and submitts for bids on the item, using the small businessman's own plans and specifications as the basis on which bids are to be submitted.

A vital need, according to SBA, is protection for the small businessman and his proprietary items which he has developed with his own funds, but still must deal with a military officer or large prime contractor to sell his product.

United Front

Sussman said that an absolute necessity for small businessmen will be for them to make an effort to protect their proprietary interests through SBA, to present a united front both in Washington and at the local level. Although he said the Washington-based officials seem to understand the situation, the local government officers are not as clearly informed.

Sussman cited an example wherein recently a major company displayed an item publicly which it claimed would give it an advantage in commercial relations. However, he said, this firm had been developed with military research and development funds. He noted that the company is claiming the commercial rights to this item.

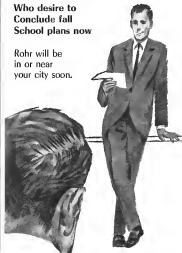
When a question was asked concerning the matter of using drawings and specifications of proprietary items, an answer was proposed in which the developer was entitled to meet schedule and quality in production of his item. The answer to this would obviously be, Sussman said, that he should be financially rewarded for his proprietary interest, either by allowing other subcontractors to sublicense or produce, the item on a royalty basis, since the item is definitely required in the national defense effort if it is placed in production with other firms.

Concerning revision of regulations to protect proprietary rights, a Navy representative declared he actually felt the regulations as they presently are suggested are all right. He allowed,

TO ENGINEERS

**Who desire to
Conclude fall
School plans now**

**Rohr will be
in or near
your city soon.**



Professional opportunities in Southern California for engineers in these fields: Structures, Design, Welding, Bonded Structures, Liaison, Industrial. Men from Rohr will soon be conducting personal interviews in the following cities:

Akron
Baltimore
Buffalo

Chicago
Cincinnati
Dallas

New York
Philadelphia
St. Louis

Detailed answers from qualified applicants will be held in confidence and given prompt attention in the assignments of local contractors. Address: J. L. Hibel, Industrial Relations Manager A-1, Rohr Aircraft Corporation, Chula Vista, California.





BASIC TEST FOR MEDIA SELECTION:

Ask anyone,
anyone
you're trying
to sell in the
aviation market,
what publication
he reads and
respects most.

A powerful editorial force is a powerful selling force.

Aviation Week

including Space Technology

A McGraw-Hill Publication, 120 West 46th St., New York, N.Y. 10036

Aviation's largest engineering-management audience
ABC PAID CIRCULATION 75,990



AIR TRAFFIC CONTROL – AIR DEFENSE INTEGRATION:

Project CHARM

One Example of the Pioneering Concepts Attracting Engineers & Scientists to



Established only a year ago under the sponsorship of the Massachusetts Institute of Technology (MITRE), in an role as technical adviser to the USAF's Air Defense Systems Integration Division (ADSID), it promotes an **active, experimental** program directed at coordinating and integrating the nation's existing **air traffic** systems with present and future **air defense** systems.

As an integral part of this long-term program MITRE has designed and implemented an experimental system called CHARM (CAA, High Altitude Remote Monitor). Utilizing the Whetstone computer with its associated display and input/output system and parts of the MITRE operational radar network (serving most of New England) the system is being operated with the cooperation

all the Boeing Air Route Traffic Control Centers
is being used in this case:

- Joint use of data sources, computers and communication links
- Data transfer methods between the two systems
- Increased capabilities for both systems through utilization of advanced computer technology

The ten vehicle CHARM units to be replaced by a more sophisticated system using advanced technology with improved computer and data processing capability.

For engineers and customers with an interest in air traffic control and its related problems there are constant sessions on:

System Design • System Engineering
Communications Planning • System Test & Evaluation
Real-Time Computer Programming

Consequently located in suburban Rome, MITRE's modern research facilities include fully equipped electronics laboratories and two large state-of-the-art digital computers—the IBM 709 and an experimental SAGE AN/FSQ-7. These machines will soon be augmented by an IBM 7080 and a solid state SAGE computer.

To arrange a confidential interview,
please call Susan M. Sandstrom, Professional Personnel Director
THE MITRE CORPORATION
344 Wood Street - Lexington 78, Massachusetts

ELECTRONIC ENGINEERS

Participants were regular personnel with B.S. or equivalent, M.S., Ph.D. and 0 to 10 years of related experience.

Assignments in the following areas

ANTENNA DESIGN
DYNAMICS
ELECTRONIC DESIGN
ELECTRONIC WRITING
OPERATION ANALYSIS
and RESEARCH
PRELIMINARY DESIGN
RADOME DESIGN
SUSTAINING

PHYSICISTS

Fieldwork often requires personnel with M.S. or Ph.D. and 3 to 10 years experience.

ELECTRONICS ENGINEERS

... CAN YOU IGNORE THIS **OPPORTUNITY?**



INTERESTING NOTE: MY VIDEO ON THIS ALSO COULD BE USED IN YOUR BROAD PICTURE.

PERIST • ROYAL OAK • NEW YORK • CHICAGO • WASHINGTON • ST. LOUIS • JAMES CITY • BALTIMORE • INDIANAPOLIS • EL PASO
MINNEAPOLIS • DALLAS • CINCINNATI • ST. LOUIS • WASHINGTON • PHILADELPHIA • BOSTON • DAYTON • CLEVELAND

CONVAIR-POMONA
Home of the successful Terrier and Terrier Mixtures
in SOUTHERN CALIFORNIA

Engineers discover various career stability and unlimited individual growth here at CORVAIR-POMONA, America's first fully integrated missile plant, engaged in research, development and production of missiles and highly advanced (all classified) weapons systems.

The enviable location of this modern, air-conditioned glass office encompasses living and dining. Suburban Pomona is only thirty minutes from Los Angeles and Hollywood and is close proximity to many recreational regions, the mountains, desert and ocean. Corporate Pomona is ideal for personal achievement and is within America's fastest growing urban climate.

Forward resume at once, so arrangements for your personal interview can be made. Write to Mr. E. L. Chase, Engineering Personnel Administrator, Dept. EE-4.

CONVAIR/POMONA
a Division of
GENERAL DYNAMICS
CORPORATION
POMONA, CALIFORNIA

ADVANCED FUEL MANAGEMENT ...FROM SMI

The requirements of accurately tanking missiles with propellants is but one of the areas of fuel management in which Servomechanisms, Inc. has demonstrated capability. *Propellant utilization and thrust control* are other areas in which SMI has developed highly accurate and precise measuring and control systems.



SMI's LOX Tanking Computer, which has been in production for the past year, accurately measures, controls and indicates the level of liquid oxygen in missile tanks. Loading is accomplished rapidly and accurately due to a unique two-mode control system. The first mode permits extremely high pumping rates until about 98% capacity is reached. The second mode then takes over and controls a precise proportioning valve which adds the necessary LOX to fill the tank within 0.1% accuracy. The second mode also provides continuous topping, thus compensating for LOX evaporation losses during standby.

SMI has currently in development, more advanced fuel management systems to meet the increasingly complex requirements of the next generation of missiles and spacecraft. SMI would welcome the opportunity to discuss and propose solutions to your fuel management problems. Write for descriptive literature.

Positions are available for qualified engineers and scientists in the areas of:
Systems Synthesis and Analysis—Project Management
—Qualification and Environmental Test Engineering—
High Vacuum Deposition Techniques.



LOS ANGELES OPERATIONS: 12500 Aviation Blvd., Hawthorne, Calif.
MECHATROL DIVISION: Westbury, L. I., New York
RESEARCH AND DEVELOPMENT CENTER: Goleta, California

The products of SMI are available in Canada and throughout the world through Servomechanisms (Canada) Limited, Toronto 15, Ontario